TECHNOGRAPH

CTOBER VOLUME 79 NUMBER 1 25 CENTS

Two ways to get out of college

Earth's attraction for an apple?
Free fall in relativistic space?
A complex meson field?
Built-in return power for project Mercury?
How is it related to binding energy?

Gravity is both a bane and a boon to man's efforts—and a thorough understanding of it is of great significance in the completion of Allison's energy conversion mission.

Gravity conditions our thinking on advanced assignments. For example, in outer space there is a disorientation of conventional design. The fact that large accelerations can be obtained with low thrust forces has taken us into the new field of electrical propulsion, ion and magneto-hydrodynamic rockets.

In our inquiries, we supplement our own resources by calling on many talents and capabilities: General Motors Corporation, its Divisions, other individuals and organizations. By applying this systems engineering concept to new projects, we increase the effectiveness with which we accomplish our mission—exploring the needs of advanced propulsion and weapons systems.

Energy conversion is our business

ALLISON

Division of General Motors, Indianapolis 6, Indiana

Opportunity, challenge . . . or both?

To the talented college graduate, eager to test his skills, Phillips Petroleum Company offers both an opportunity and a challenge. The opportunities are manifold . . . from research to sales in broad activities relating to petroleum and petrochemical products, agricultural chemicals, aviation and marine products, plastics, rubber and rubber chemicals, and atomic energy. The challenge is irresistible . . . because it is a challenge to the mind . . . a challenge to develop within the unlimited horizons of the petroleum industry with the finest facilities at hand.

It is our belief that progress is assured through the creation and maintenance of an atmosphere in which every employee's potential may be fully realized.

Investigate your opportunities with us. Arrangements for an interview with a Phillips representative may be made through your College Placement Office.

For full details, write to our Employee Relations Department.

PHILLIPS PETROLEUM COMPANY
BARTLESVILLE, OKLAHOMA

PHILLIPS 66

An equal opportunity employer

THE ILLINOIS

TECHNOGRAPH

VOLUME 79, NUMBER 1 OCTOBER, 1963

table of contents

Editorial 3

TECHNOGRAPH's New Look *H. L. Wakeland* 5

The New Civil Engineering Building 6

The Supernatural Behavior of Superconductors *Stuart Umpleby* 8

Student Discount on Engineering Publications 12

A Year of Achievement 15

The Illinois Society of Professional Engineers 17

Two New Centers for Direct Interaction with Industry 20

Engineering Societies Calendar 26

Technocutie *Photo by Joe Figueira* 29

A Decade of Achievement in India 32

Science, Technology, and Space Navigation 33

Friction: A Tool for Welding 33

The Society Page 36

What Do You Know About Co-op Programs? *Larry Heydo* 38

Why Does a Culvert Cross the Road? 43

Brickbats 'n Bouquets 48

THE COVER

Dave Busby of Indianola was the first freshman in engineering to register in the Centennial Graduating Class last September. He and his classmates are scheduled to graduate on the University's one-hundredth birthday. Those who follow the course shown on the left will do so; the easy way shown on the right will lead to getting out earlier—much earlier! (Cover Editor, Larry Pflederer.)

 Published eight times during the year (October, November, December, January, February, March, April and May) by the Illini Publishing Company. Entered as second class matter, October 30, 1920, at the post office at Urbana, Illinois, under the Act of March 3, 1879. Office 48 Electrical Engineering Building, Urbana, Illinois. Subscriptions $2.00 per year. Single copy 25 cents. Publisher's Representative—Littell-Murray-Barnhill, Inc., 737 North Michigan Ave., Chicago 11, Ill., 369 Lexington Ave., New York 17, New York.

WHY THE CHANGE?

In 1967, the University of Illinois will be one hundred years old. This semester's engineering freshmen will be graduating (they hope!). They will obviously have a real first in being members of the centennial graduating class. We believe they will be first in another respect also: they will be the first graduates to be given a real opportunity to learn more about their chosen profession, their college, and their university. We are going to provide a part of this opportunity by making **Technograph** available to every undergraduate as a source of news concerning this campus, as well as an open forum for discussion, debate, and exchange of opinion between engineering students and faculty. The rest is up to you—student or faculty member.

Faculty members cannot be effective teachers without feedback from their students, and students cannot derive the full benefits of attending college without knowing what is going on around them. Students need to know what is happening in U of I research and what it means to them. They should be informed about policy changes of the administration and what these changes mean to them, and they have a responsibility to themselves and to each other to express their views and to ask about things they do not understand. The College's administrators agree with this point of view and have offered their support. The remainder of the responsibility now lies with you—what you don't know **may hurt you.**

Our pages are your pages. If you don't wish to write your views yourself, then drop by, tell us what you have on your mind, and we'll write it for you. Every professional engineer is aware of the benefits of publishing articles, and undergraduates and graduates can also benefit by getting articles published in **Technograph.** But the most important thing is for each of us to realize that he is a link (hopefully not the weakest one!) in a vital communication chain.

If the members of the class of 1967 leave with an unprecedented awareness of their college, they will be the first to do so . . . and they will be the best equipped engineers ever to leave this campus. We have a responsibility, not only to the centennial graduating class, but to ourselves and all the engineering students who will enter and leave the U of I College of Engineering over the **next** one hundred years. Will you help?

TECHNOGRAPH'S NEW LOOK

by Assistant Dean H. L. Wakeland

As you leaf through the *Technograph* have you asked yourself—who sent this magazine; who paid for it; why was it sent to me? The answers to these questions will vary slightly from one reader to the next, but a closer observation will show that the *Technograph* has taken on a new look.

Beginning this fall, each engineering student in the College of Engineering, as well as students in Chemical Engineering, Architectural Engineering, and Industrial Design will receive a free copy of *Technograph* each month by mail at their individual campus addresses. Engineering staff members will receive the first issue free but will be asked to subscribe for additional copies at the rate of two dollars per year. All high schools throughout Illinois will also receive copies financed by the College of Engineering.

The magazine has changed its content and hopes to serve as a medium for the exchange of information and ideas between students and staff. New features are to include notes about alumni, student activity news, contributions by the faculty, engineering departmental news, and letters to the editor—providing you write. In fact, only a few portions of the magazine will remain unchanged.

In the February, 1963, issue of *Technograph* I wrote briefly about "Student Comment and Opinion" stating that we simply did not get student "play back" (i.e. opinions or ideas from engineering students about our college or educational program). Gary Daymon, one of *Technograph's* most active staff members, answered by pointing out that no convenient vehicle was available through which students could express their opinions. Although students had the campus daily and other mediums available to express their viewpoints, it was true that there was no common medium for engineering students except the *Technograph*, which had not been adequately fulfilling this need.

Assistant Dean H. L. Wakeland

Technograph staff members and faculty members immediately began to discuss ways in which *Technograph* might be changed to meet this need. One of the first needs was to reach each engineering student with the publication. In past years much time had been spent in selling subscriptions and after each sales campaign *Technograph* ended up with only a small portion of the engineering student body subscribing. Was there an economical method to be used that would place a copy in each student's hand and do away with subscriptions?

In recent years a number of science or trade magazines have completely eliminated paid subscriptions and paid for publication solely through advertisement. These magazines limit subscriptions to qualified people but mail them free of charge to approved subscribers. Many experienced journalists doubt the usefulness and quality of a "give away" publication but magazines such as "Science and Technology" and "Datamation" provide excellent examples of high level publications distributed in this manner.

Well, to make a long story short, *Technograph* has had a substantial advertising income in the past few years and with some juggling of figures and backing from the Illini Publishing Company, they are trying to make 1963-64 their first successful year of controlled subscription distribution.

A little additional income is needed to balance the books and it is hoped that the majority of staff members will help by subscribing. Faculty readers are needed to complete the exchange of ideas, opinions, and news which *Technograph* hopes to provide.

The second need is to provide more useful or pertinent information for engineering readers: student activities that are available and how

(continued on page 43, column 3)

THE NEW C. E. B.

1868

The first U of I building, built in 1868, was located near the site where the new CEB will be constructed.

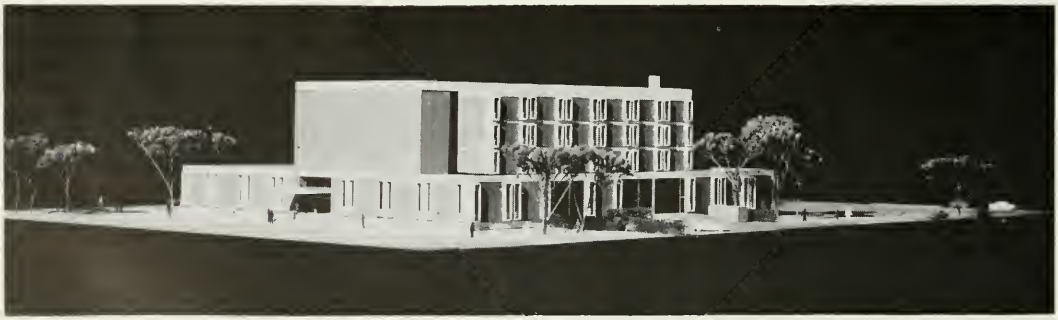
Quite a contrast to the $150.00 invested in the first U of I building is the new $4,216,000 CEB structure being constructed near the site where, in 1868, the University's first building was located. (A witty [?] student remarked, "But it cost less to live in those days.") Financed through the new State Building Authority, the structure will bring together Civil Engineering activities now located in 15 different buildings.

The initial building will consist of four stories and basement, devoted principally to department offices and laboratories for research and teaching in concrete structures, soil mechanics and foundations, and sanitary engineering. Its central feature will be a three-story laboratory with a specially reinforced floor to support modern structural research equipment. Smaller laboratories will be located over and around the structural research laboratory.

To allow for flexibility in research technology and problems, there will be little built-in equipment on the 40,000 square feet of available space. Current plans will utilize part of this space for expanded research in concrete, soils, and sanitary engineering. The sanitary engineering department will also use the roof for air studies.

The U of I Civil Engineering Department, headed by Prof. Nathan M. Newmark, consists of over 600 undergraduates and 280 graduate students—the world's largest graduate enrollment in this field. It has a full-time academic staff of 93, 82 graduate assistants working half time, and a nonacademic staff of 60 technicians, specialists, and others. Currently, 60 civil engineering research projects annually total over $1,500,000. GMD

1965

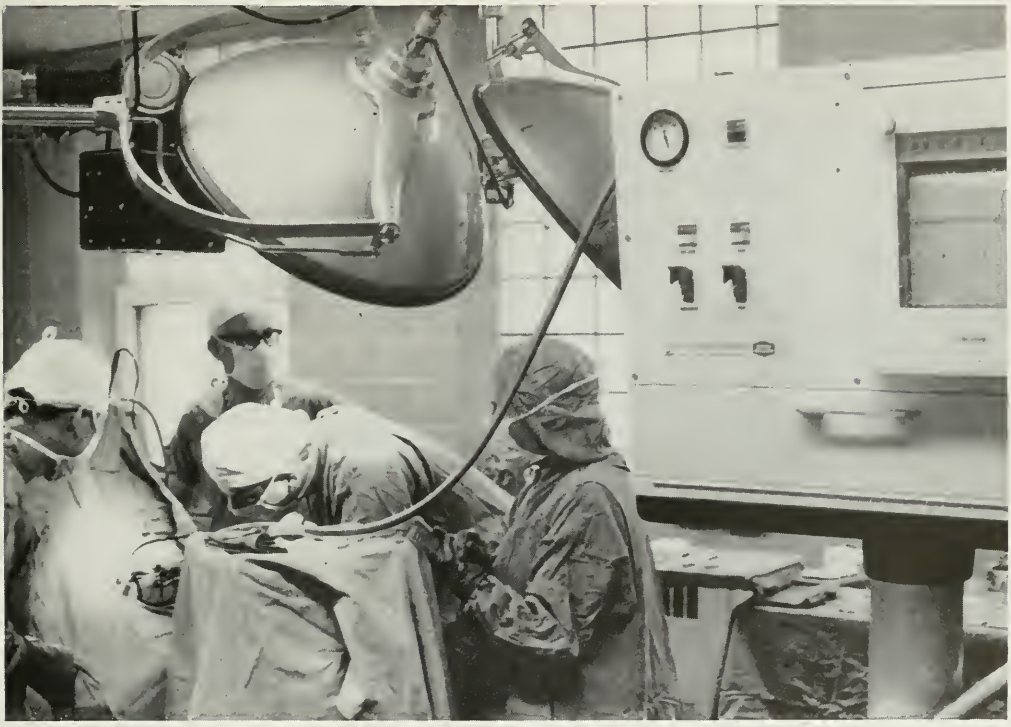


The new Civil Engineering Building is located on Romine Street between Stoughton and Main. Just north of the new structure is the University's Digital Computer Laboratory where future tie-in cables will provide facilities for many civil engineering research projects.

Architects for the new CEB are A. Epstein and Sons, Chicago. The founder of this firm and his sons who are now operating it are graduates of the U of I department of Civil Engineering. Designers of the building are Richardson, Severns, Scheeler and Associates, Champaign. Bids will be received in December; completion is scheduled for September, 1965.

LINDE Assignment:

Develop a new surgical tool to freeze tissue, save lives



You work on projects that benefit mankind when you're with Union Carbide's Linde Division. Consider this new cryogenic surgical equipment, for example. It's used by major hospitals in the United States, Canada, and Europe for treating the symptoms of Parkinsonism and other involuntary movement disorders.

Back in 1961, a new surgical technique, using extremely cold temperatures, was announced to the medical profession.

In brief, this surgical procedure involves making a small burr hole in the patient's skull; directing the probe into the thalamic target; and using liquid nitrogen to freeze the appropriate tissue.

Because of its extensive experience and capabilities in cryogenic systems, Linde Division was called upon to develop and produce the needed cryosurgery device—a precision surgical probe and a complete system capable of furnishing controlled cold to the probe.

The result is the CE-2 Cryosurgery Equipment, a fully automatic unit that is easy to operate and maintains preselected temperatures reliably.

The CE-2 permits using the ultra-low temperature of liquid nitrogen (—320° F.) as a surgical tool with precision and safety in a practical operating range of 98° to —240° F.

Work with LINDE and you work with heat, cold, pressure, vacuum. You have a choice among programs in cryogenics, plasmas, Flame-Plating, electronics, biochemistry, crystallography. Before deciding on any job, get to know all that's going on at LINDE.

For information, write Recruiting Department, Union Carbide Corporation, Linde Division, 270 Park Avenue, New York, N.Y. 10017.

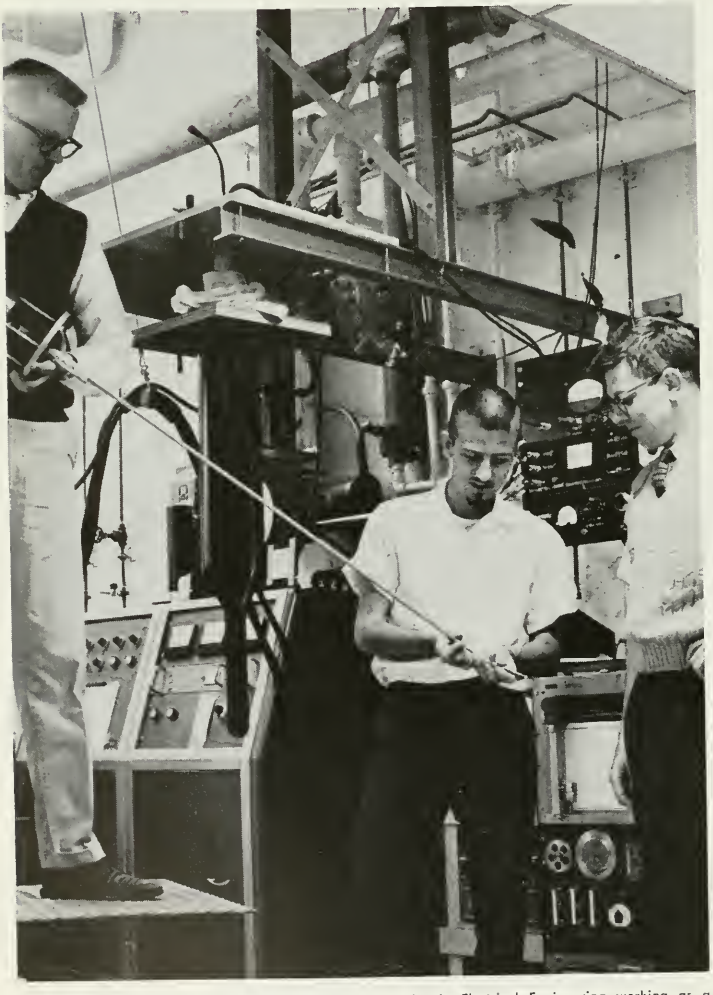
A Linde assignment poses a challenge

UNION CARBIDE LINDE DIVISION

AN EQUAL OPPORTUNITY EMPLOYER

THE SUPERNATURAL BEHAVIOR OF SUPERCONDUCTORS

by Stuart Umpleby, ME '66



Bill Gentry, Fansteel representative; Roger Ries, a junior in Electrical Engineering working as a laboratory technician; and Professor Satterthwaite prepare a magnetometer for an experiment measuring the diamagnetic susceptibility of a superconductor.

In a discipline like superconductor research, this morning's discovery is liable to be this afternoon's product. For this reason, such research requires a close cooperation between industries and universities; neither can afford to fall behind, and only the traditionally quick response time of industry coordinated with the breadth and depth of university facilities and talents will keep them both up to date. A good example of such cooperative efforts is seen in the recent arrival of the College of Engineering's first Visiting Industrial Associate, Mr. W. O. Gentry of the Fansteel Metallurgical Corporation of Chicago.

Mr. Gentry is working with Dr. C. B. Satterthwaite, Associate Professor of Physics in the Coordinated Science Laboratory. Dr. Satterthwaite's group is doing advanced research on superconductor materials, a subject of great interest to Fansteel because the company produces these exotic metals. Mr. Gentry is here under the auspices of the Visiting Industrial Associates Program, which is sponsored by the Midwest Electronics Research Center (described in more detail on page 23). He is no stranger to the campus; he did his undergraduate work in engineering physics here during 1953-57.

The quest for superconductor materials that brought Fansteel to the University started over fifty years ago when Kamerlingh Onnes, a Dutch physicist, succeeded in liquifying helium, thereby opening investigations in the temperature range below 4.2°K. Onnes thought that the resistance of a material might vanish at absolute zero. However, subsequent experiments showed that the best con-

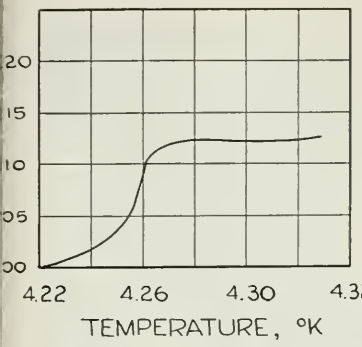


Figure 1. Resistance of mercury as a function of temperature.

ductors at room temperatures, such as platinum, gold, silver, and copper do not become superconductive; rather, their resistance becomes a constant of small magnitude as the temperature drops below 10°K. Onnes supposed that impurities were responsible for his imperfect results and turned his investigations to mercury which he could obtain in purer form. Although the resistance of the mercury dropped to zero, it did so at a temperature slightly above 4°K and much more abruptly than Onnes predicted (Fig. 1). Further experimentation revealed that impurities did not prevent mercury from becoming superconductive.

Research since that time has established that none of the alkali, noble, ferromagnetic, or antiferromagnetic metals are superconductors, although examples from each of these classes are found in superconducting compounds. Nearly all crystal classes are represented. Also, superconductivity is most apt to occur in elements or compounds having 3, 5, or 7 valence electrons per atom. Twenty-three elements plus many compounds and alloys are known to exhibit superconductive properties. (See Table #1.)

As research continued, investigators discovered that some properties remained the same and that others, in addition to resistance, changed when materials became superconductive. Following the original discovery of superconductivity, it was assumed that the magnetic field in a metal remained constant as the metal became superconductive, but in 1933 experiments by Meissner and Ochsenfeld indicated that the field inside a pure superconductor was zero. In other words, pure superconductors appear to have zero permeability (Fig. 2).

Onnes also discovered that a magnetic field caused restoration of resistance in superconductors. The critical field is that field which restores resistance at a given temperature. The magnetic field must be decreased below this critical field, H_c, to restore superconductivity.

Since a superconductor has no resistance, very high currents may be induced. If the current in a superconductor produces a surface field which equals or exceeds the critical field, the metal regains its resistivity. This phenomenon, known as the Silsbee effect, provides a practical limitation in the use of superconducting circuits. The critical field at absolute zero, H_o, and the critical temperature are two bases for comparison of SC elements, compounds, and alloys (Fig. 3).

Early research therefore resulted in several basic conclusions about superconductors: (1) in general (aluminum being the exception) superconductivity is associated with high room temperature resistivity; (2) superconductor materials become superconductive abruptly at a threshold temperature above 0°K; (3) superconductors are perfect diamagnets; and (4) a magnetic field causes restoration of resistance and the critical magnetic field is a parabolic function of the temperature.

The most recent and currently accepted theory of superconductivity was developed at the University of Illinois. In 1957 Professors John Bardeen, L. N. Cooper, and J. R. Schrieffer created what has become known as the BCS theory. Their theory attributes superconductivity to a gap in the energy levels of a superconductor through which the conduction electrons move. This gap is produced in the following way: an electron moving through the crystal lattice collides with it and subtly changes the vibrational pattern of the lattice. This small change is in turn communicated to another electron traveling in a direction opposite to the first. In this fashion, which can be properly described only in quantum mechanical language, electrons tend to interact in pairs and in such a way that their energy is reduced. When this interaction is summed over all pairs of electrons traveling all directions in the metal, the net result is an over-all lowering of electron energies sufficient to leave the energy gap postulated by the theory.

Under the present cooperative research program at the University, the Fansteel Corporation is interested in finding new superconductive materials that are more machineable and that have higher critical magnetic fields than presently known superconductors. To accomplish this, they wish to gain some expert knowledge in superconductivity; Mr. Gentry has joined Dr. Satterthwaite's group for that reason. The interests of the University are to produce useful new knowledge, to understand the basic phenomena of superconductivity, and to provide research training for the graduate program.

Finding and isolating such materials is often a complicated engineering problem. One of the most recently discovered materials, a compound of

SUPERCONDUCTIVITY

Element	T_t(°K)	H_c(oersteds)
Technetium	11.2	300-400
Columbium	9.22	
Niobium	9.2	2000
Lead	7.22	807
Lanthanum	5.9	1600
Vanadium	5.03	1310
Tantalum	4.39	780
Mercury	4.16	413
Tin	3.72	305
Indium	3.40	278
Thallium	2.39	171
Rhenium	1.70	201
Thorium	1.37	131
Aluminum	1.20	106
Gallium	1.09	59
Uranium	.68	
Zinc	.79	53
Asmium	.71	65
Zirconium	.55	47
Cadmium	.54	29
Ruthenium	.47	46
Titanium	.39	20
Hafnium	.37	

Table 1. Transition temperatures and critical fields at absolute zero of the superconducting elements.

niobium and tin, was needed in a fine wire form but was not pliable enough to be drawn, as wire is usually produced. An engineering study at Bell Laboratories brought forth a means for placing niobium and tin powders inside a thin tube of ordinary conducting material and heating it until the inside material became a fine, solid wire. Currents introduced into the resulting "insulated wire" did not penetrate the "insulation" because the superconducting wire had much less resistance—in fact, none.

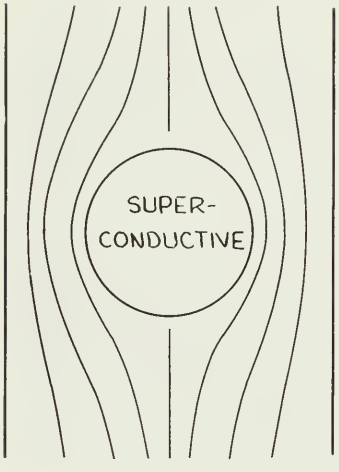


Figure 2. The Meissner effect, perfect diamagnetism, all flux excluded.

It is such problems as this that the members of Dr. Satterthwaite's group (including Mr. Gentry) are trying to solve. The possibilities of rewards for Fansteel, in terms of marketable applications, are legion: conventional magnets using copper conductors are capable of developing intense fields, but they require immense power supplies and cooling systems. In contrast, superconducting magnets capable of producing comparable fields suffer no heat losses once the field is established. A superconducting magnet consumes no energy and requires no power other than that required for refrigeration.

Superconducting magnets promise to provide the high strength magnetic fields required for "bottling" thermonuclear plasma (hot ionized gas which would melt any material container); magnetohydrodynamics experiments to study the conversion of heat directly into electricity by passing a stream of white hot gas through the field of a strong magnet; particle accelerators; magnetic shielding; floating rotor gyroscopes; no-loss motors; magnetic field-lubricated bearings; improved images in electron microscopes; use in conjunction with bubble chambers, where greater deflection of particle path will simplify the study of particle interactions; frictionless suspension; high-speed computers utilizing neither vacuum tubes nor transistors; more efficient storage of electricity; and metal forming using powerful magnets to squeeze hard-to-work metals into complicated shapes.

The program in superconductivity is one of a number of research areas near the forefront of scientific investigation in which the University is engaged. "In order to maintain a vital scientific and engineering atmosphere," according to Dr. Satterthwaite, "the University must maintain a high level of research. To remain effective as teachers of science and engineering, the staff must actively participate in acquiring new knowledge, and the University must support research in order to attract good staff members. The rewards of research are not limited to the staff and graduate students alone; many undergraduate students also participate and make valuable contributions in the research programs, working as laboratory assistants or in honors programs connected with research. The entire undergraduate student body profits from research activities, in that the teachers of undergraduate courses are up to date in their fields and are able to bring the latest information to the classroom. This is important in all fields of engineering, but especially so in a field like superconductivity, where this morning's discovery is not only liable to be this afternoon's product, but perhaps included in this afternoon's lesson in the classroom."
[. . . and probably in tomorrow's exam! Ed.]

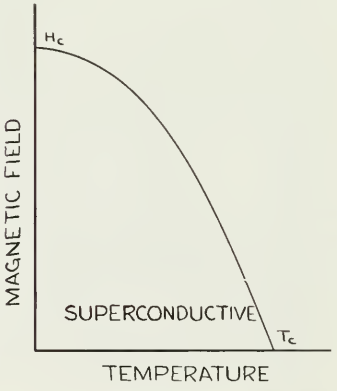
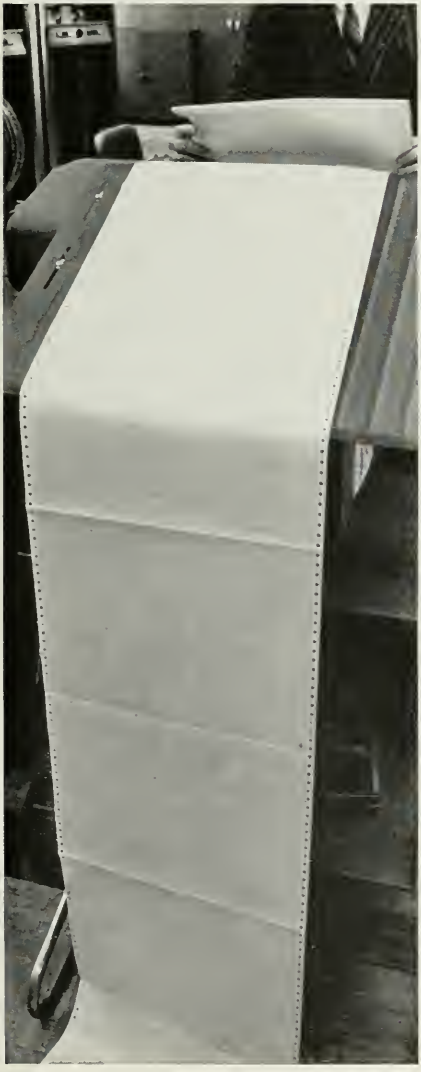


Figure 3. Typical Silsbee transitian curve below which a material is superconductive.

The First Five Years of the Engineer

In 1958 the University of Illinois College of Engineering graduated 733 engineers. In a recent survey by the Engineering Placement Office to discover what had happened to these people over the last five years, some interesting facts turned up: 438 of them responded to the survey; the average starting salary in 1958 for these men was $486.83 a month; 409 are gainfully employed today; their average monthly salary is $809.48, a gain of 66.28% over the five-year period. But—83 of them had taken out from one to four years to complete an advanced degree, and 99 of them are working on advanced degrees now. Another 103 of them spent from a few months to four years of the five year period in the armed services.

It is obvious that the graduates who have spent all or most of the five years working have done very well; how have the ones who took some time off for advanced college work done? Of the 409 engineers now working, those with no advanced degree have an average monthly salary of $794.64. In spite of the time they had to be away from their jobs over the five-year period, those with master's degrees are averaging $846.84; and those with doctorates are averaging $1032.71 a month. It appears that the money lost in not being gainfully employed while getting advanced schooling is more than recovered in the engineer's ability to command a higher salary if he holds advanced degrees. Better think long and hard about graduate work. . . .



WHO DOES THE THINKING FOR THINKING MACHINES?

Even though we didn't invent it, we at American Oil use the computer so extensively in Linear Programming that we often think of it as "our baby." And as such it must be spoon-fed known data by experts in order to come up with the answers to a myriad of refinery operation problems.

One of the experts at American Oil who helps the thinking machine think is Leonard Tenner, 24, a graduate Chemical Engineer from M.I.T. His current assignment: prepare a mathematical model covering the manufacture of gasoline, home fuel and jet fuel from crude oil.

The fact that many gifted and earnest young men like Len Tenner are finding challenging careers at American Oil could have special meaning for you. American Oil offers a wide range of new research opportunities for: Chemists—analytical, electrochemical, physical, and organic; Engineers—chemical, mechanical, and metallurgical; Masters in Business Administration with an engineering (preferably chemical) or science background; Mathematicians; Physicists.

For complete information about interesting careers in the Research and Development Department, write: J. H. Strange, American Oil Company, P. O. Box 431, Whiting, Indiana.

IN ADDITION TO FAR-REACHING PROGRAMS INVOLVING FUELS, LUBRICANTS AND PETROCHEMICALS, AMERICAN OIL AND ITS AFFILIATE, AMOCO CHEMICALS, ARE ENGAGED IN SUCH DIVERSIFIED RESEARCH AND DEVELOPMENT PROJECTS AS: Organic ions under electron impact / Radiation-induced reactions / Physiochemical nature of catalysts / Fuel cells / Novel separations by gas chromatography / Application of computers to complex technical problems / Synthesis and potential applications for aromatic acids / Combustion phenomena / Design and economics: new uses for present products, new products, new processes / Corrosion mechanisms / Development of new types of surface coatings.

STANDARD

STANDARD OIL DIVISION
AMERICAN OIL COMPANY

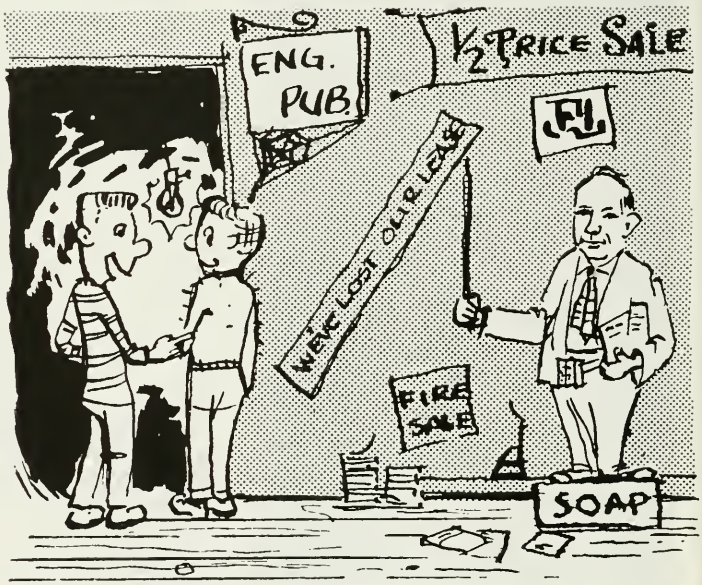
STUDENT DISCOUNT ON ENGINEERING PUBLICATIONS

The Engineering Experiment Station has been in the publications business almost as long as *The Illinois Technograph—Tech* started in 1886, while the Station didn't begin publishing until 1904. This comparatively late start is explained by the fact that the Station, although it was the first Experiment Station in the United States, didn't exist before 1903. Now this newcomer to the publishing business has asked *Tech*, with its long background of practical experience and know-how, to publicize a new policy of student discounts on the younger organization's publications.

In order to respond intelligently to this request, *Tech* staff members felt compelled to look into the reputation of the Station and its publications program; we were finally forced to admit that their credentials look nearly as good as *Technograph's*. Like us, they publish a considerable number of publications, they distribute them all over the world, and they have managed to get them into the world's best engineering libraries. In fact, and again somewhat grudgingly, we feel obligated to point out that many of the bulletins and circulars from other universities are available in our library because of the reciprocal agreement those institutions have with the Station and the College: they get our technical publications and they send us theirs. There are approximately 1,000 such libraries around the world that have entered into this trade arrangement.

In view of this successful, if short, history, and appearance of probable longevity, we have agreed to do for the Station what its world-wide communications net cannot do: communicate with the students of the College of Engineering. The announcement is: effective immediately, students of the College of Engineering can purchase at half-price any Bulletin, Circular, or Technical Report published by the Station. This represents a financial loss for the Station because the prices of these publications are calculated just to cover the cost of printing, but it is being done as a service to the student. No written approvals by instructors are required for the discount. Students who wish can get a list of available publications free of charge from 112 Civil Engineering Hall. End of message. . . .

We of *Technograph* feel that this represents a fair spirit of cooperation toward the students, partly because we realize that if we had no more experience in the publishing business than the Station we would probably have to reduce our price too. But since we are the oldest continuous publication on the engineering campus, we will maintain our price for subscribers and give *Tech* to the students of the College. Perhaps when the Station has been at this as long as we have. . . .



TECH was right; they are half price.

This Brochure Tells How You Can Advance Your Professional Career at Allison

So, you're close to finishing your regular college curriculum. What then? A job, of course, but how about continuing your learning?

Allison's broad education and training programs encourage the young graduate engineer to seek education beyond the normal four or five year college course.

We'd like to tell you more about our Advance Study Program: *The Tuition Refund Plan . . . Graduate Study Program . . . Technical Training Program . . . and Accelerated Experience Program.* The AEP is designed to help the new engineer gain on-the-job experience in the shortest possible time. It's directed toward new engineers in Mechanical Engineering, Aeronautical Engineering, Electrical Engineering, Industrial Engineering, Engineering Science, Mathematics, Chemistry and Metallurgy.

Interested? Talk to our interviewer when he visits your campus. Or, write now for your copy of Allison's brochure, explaining your opportunities in Advance Study and our Accelerated Experience Program. Send your request to: Allison Division, General Motors Corporation, Indianapolis 6, Indiana. Att: Professional and Scientific Placement, Dept. 1801.

An equal opportunity employer

Allison
THE ENERGY CONVERSION DIVISION OF GENERAL MOTORS, INDIANAPOLIS, INDIANA

GM GENERAL MOTORS

Floating on air...cushioned in foam

Sleeping is like floating on air, when the mattress is made of urethane foam . . . a mattress that "breathes" air through every cell, and weighs so little that a housewife can lift it over her head! ▶ By combining exact proportions of five chemicals from Union Carbide, this versatile foam can be made soft, firm, or rigid. Mattresses, upholstery, and pillows can be given their own degrees of resilience. Other formulations produce superior insulation in the form of prefabricated rigid panels or foamed in place. In a refrigerator trailer body, this insulation can be used in much thinner sections than conventional materials, so cargo space is increased substantially. ▶ Recently, Union Carbide introduced "climate-controlled" polyether, which results in uniform foam properties despite such curing variables as summer heat and humidity. Another Union Carbide development is production of the first polyether for flame-lamination of thin foam sheets to cloth, adding warmth without noticeable bulk. ▶ In their work with chemicals, the people of Union Carbide have pioneered in developing polyethers and silicones for urethane foam, found new uses for the foam, and shown customers how to produce it.

UNION CARBIDE

A HAND IN THINGS TO COME

WRITE *for booklet DD, "The exciting Universe of Union Carbide," which tells how research in the fields of chemicals, carbons, gases, metals, plastics, and nuclear energy keeps bringing new wonders into your life. Union Carbide Corporation, 270 Park Avenue, New York 17, N.Y. In Canada: Union Carbide Canada Limited, Toronto.*

A YEAR OF ACHIEVEMENT

It would be impossible to outline every activity of the College of Engineering last year; however, the following excerpts from Dean Everitt's annual report to the President should provide students with a brief glimpse of the 1962-1963 period.

Educational Programs

Engineers are the most important product of the College of Engineering, and educating them is the College's most important project. Continuous striving over the years for high educational standards has not resulted in low numbers in the undergraduate enrollment, graduate enrollment, or degree granted columns. Although comparative figures for 1962-63 are not yet available, the record should compare well with the previous year, when the University of Illinois, according to the U. S. Office of Education, granted more engineering degrees than any other institution in the United States: 669 B.S., 327 M.S., and 94 Ph.D. degrees. In addition, 53 B.S., 56 M.S., and 27 Ph.D. degrees were awarded in Physics.

One significant happening of the year was that a new program in the humanities and social sciences, requiring every engineering student to take at least 18 semester hours in these fields, was established.

The College's Honors Program was quite active with a total of 135 students participating, and several new ideas were implemented such as a program in Civil Engineering allowing carefully selected honors students to receive tutorial teaching from the staff during their senior year. Student placement activities were vigorous: in the fall of 1962 a total of 314 companies visited the campus to interview engineering graduates, and

Dean W. L. Everitt

385 of them visited during the spring of 1963. In addition, the Engineering Placement Office published and offered to industry a semester report, an annual report, and a five-year report on employment of our graduates.

Research Programs

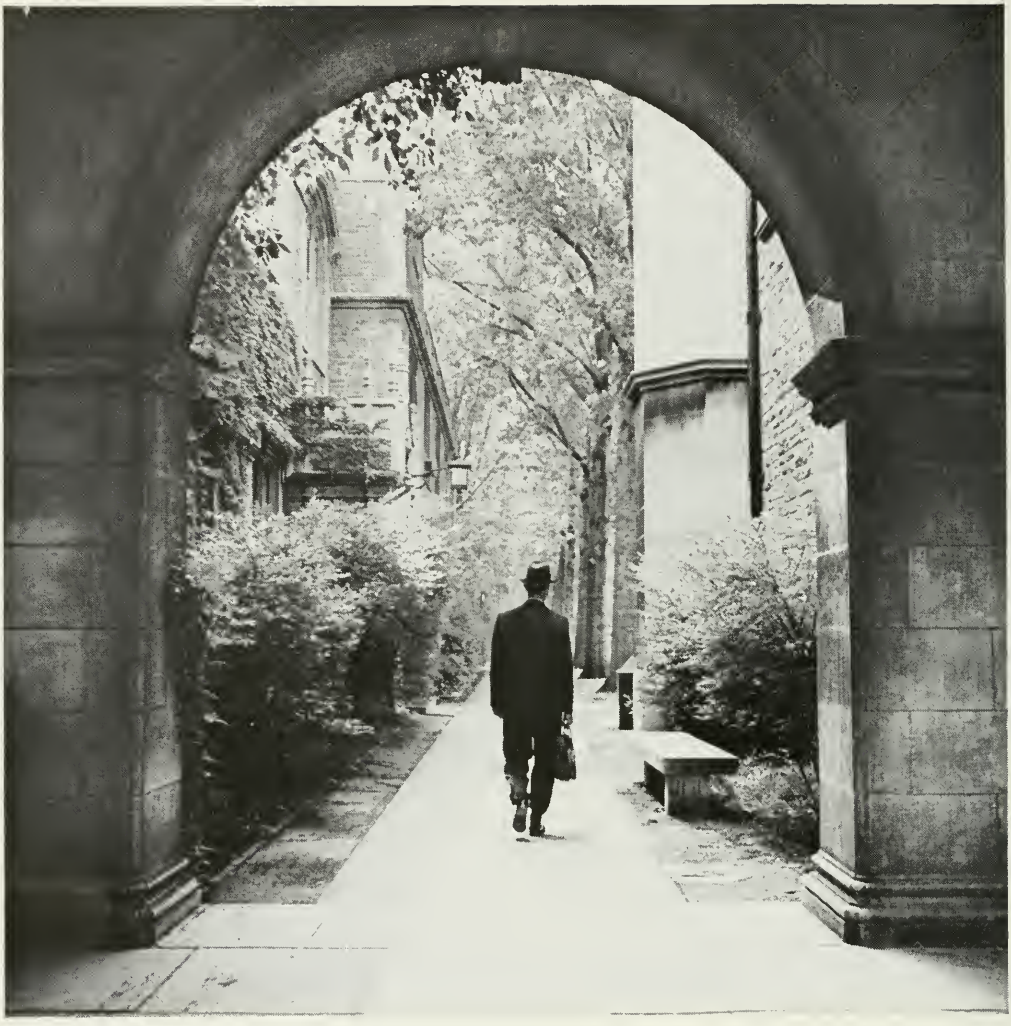
The year witnessed the College's involvement in 439 separate research projects, 308 of which were sponsored by 32 private companies, 11 industrial organizations, 7 private foundations, and 36 federal and state agencies. The remaining 131 projects were supported by University funds. Research income for the year, the highest in history, was 12¼ million dollars. The University's nuclear reactor, the only university-operated reactor licensed to "pulse" to power levels above 250 million watts, was given authorization by the AEC to pulse to one billion watts. The Materials Research Laboratory, made up of five participating departments of the College, completed its first year of operation with 22 research projects in progress and plans completed for its new headquarters. PLATO, the computer-controlled automatic teaching system of the Coordinated Science Laboratory, was given multi-student capabilities during the year.

The College was especially active in various types of participation in the nation's space program during the year. A whole new research program in aeronomy was begun, and plans were laid for the University's contribution to the NASA rocket program to study properties of the ionosphere during the coming International Quiet Sun Year. During the recent eclipse the University, in cooperation with Stanford University, carried out a major study of the ionosphere from stations in Alaska, Canada, Illinois, and Washington. Further work was completed on plans to cooperate with NASA in placing one of the Coordinated Science Laboratory's electric vacuum gyroscopes in orbit to check Einstein's theory of relativity by measuring gyro drift rate.

Public Service Programs

In addition to the usual large number of summer science training institutes, short courses, and guidance activities, the College's public service programs were increased in 1962-63, partly because of the University's expanded efforts to interact with industry. During the year the Board of Trustees approved the establishment of the Midwest Electronics Research Center as an administrative mechanism to facilitate increased cooperation with industries in electronics and related areas of solid state

(continued on page 45, column 1)



Your future in engineering is his business

He's a Monsanto Professional Employment representative... now *also* representing the other members of the Monsanto corporate family: *Chemstrand Company, Shawinigan Resins Corporation, Plax Company, Monsanto Research Corporation, Chemstrand Research Center, Inc.*

Ask him about the *diversity* these outstanding organizations offer—in geography, activities, products—diversity that offers ever-expanding opportunity to the young man of exceptional promise. Ask this expert in *futures* about the future the Monsanto family offers *you* in research, development, manufacturing and marketing.

See your Placement Director to arrange an interview when we visit your campus. Or write for our new brochure, "You and Monsanto," to Manager, Professional Recruiting, Dept. EN-10, Monsanto, St. Louis, Missouri, 63166.

Monsanto®

AN EQUAL OPPORTUNITY EMPLOYER

This year's officers of the ISPE are (left to right) Roger W. Daniels, vice-president; Robert E. Seyler, p esident; Jerlina L. Keltner, secretary; and (seated) Timothy E. Swanson, treasurer.

The student chapter of the Illinois Society of Professional Engineers serves the primary function of providing the engineering student with the opportunity to learn and understand the professional aspects of his career —that side of his training and career which is not pure science and technology. This is accomplished through its meetings, through its publications, and through wider contacts with practicing professional engineers. All bona fide undergraduate engineering students are eligible for membership.

The chapter was organized in the spring of 1961 through the efforts and financing of the Champaign County chapter, in co-operation with several faculty members. The first president was Lyle Martin of Agricultural Engineering. The national charter was received a year later, and formally presented last fall. Across the entire nation, ours is student chapter number nine at a major four-year engineering school. The campus chapter is affiliated with the State Society with headquarters in Springfield, and with the National Society with headquarters in Washington, D.C.

Through the ages a man engaged in engineering was really a military engineer, and it was as late as the middle of the eighteenth century before someone limited his practice strictly to civilian projects—and became the first "civil engineer." Now there are twelve degree-granting branches of engineering on our campus, each curriculum having one or more technical societies. The professional engineering group is the only unifying body to encompass and speak for all engineers.

The student chapter plans three meetings this fall:

October 16, in Rm. 275 Illini Union South, "Unity among Professional Engineers" showing a movie "The Dew Line," made by the Bell Telephone Co. A special invitation is extended to all freshmen and sophomores to attend this meeting.

November 13, in Rm. 151 Electrical Engineering Building, "Unions and the Professional Engineer," with Sander B. Friedman, P.E., as the main speaker. Mr. Friedman is chief engineer and general manager of the Universal Circuit Controls Corporation, Skokie.

Dec. 11, in Rm. 275 Illini Union South, "Professional Engineer's Liability in Design Failure," with George L. Sodemann, P.E., as the speaker. Mr. Sodemann is with the firm Sodemann and Associates, consulting engineers of Champaign.

All meetings are held from 7:00 to 9:00 P.M.

The current chapter officers are: President, Robert E. Seyler, General Engineering; Vice-president, Roger W. Daniels, Industrial Engineering; Secretary, Gerlina L. Keltner, Aeronautical and Astronautical Engineering; and Treasurer, Timothy E. Swanson, Civil Engineering.

The faculty advisors are David R. Reyes-Guerra and Robert A. Jewett, both of General Engineering.

Following the first stage of its membership campaign during registration week, there were 78 active members. These students will receive *The American Engineer* from the national office, and *The Illinois Engineer* from the state office. These students are also privileged to attend meetings of any of the 23 chapters throughout the state.

One of the requirements for membership in the National Society of Professional Engineers is registration as a P.E. in any state or the District of Columbia. Each of these states has its own law and examination in order to certify an individual so as to protect the health, welfare, and safety of the public. The law states: "The term professional engineer within the meaning and intent of this act shall mean a person who, by reason of his special knowledge of the mathematical and physical sciences and the principles and methods of engineering analysis and design, acquired by professional education and practical experience, is qualified to practice engineering as hereinafter defined, as attested by his legal registration as a professional engineer."

(continued on page 48, column 3)

room for

the IBM story, in brief. IBM was founded in 1914. The achievements of the company have been exceptional.

IBM develops, manufactures, and markets machines for the handling, processing, and control of data. It also installs this equipment and maintains it.

IBM products range from electric typewriters selling for several hundred dollars to complete electronic computer systems valued in the millions. In addition, IBM produces advanced systems for space programs and national defense.

IBM systems, equipment, and machines are at work in a wide range of activities covering almost every field of endeavor: in business, industry, government, research, science, education, and space exploration. IBM research is continually exploring new areas of interest in a quest for basic knowledge. At IBM, engineers and scientists are constantly at work in the development of new methods, the design of new products, and new ways to apply basic discoveries.

We welcome ideas, talent, and ability. We offer the man or woman who has them the opportunity to move ahead rapidly. Above all, IBM offers room for achievement.

technical positions. Development Engineering: Challenging design and development work will include new components, machines, and other products involving circuitry, components, data communications, guidance systems, logical design, magnetics, mathematics, microwaves, optics, solid state devices, statistics. (A B.S. or advanced degree in Electrical or Mechanical Engineering, Mathematics, or Physics.)

Manufacturing Engineering: Creative application of new methods and processes will develop advanced automation machinery to be used in the precision manufacture of complex devices and electronic equipment. (A B.S. or advanced degree in Industrial, Electrical, or Mechanical Engineering.)

Programming: Professional opportunities are available for men and women in the programming of a variety of computing systems. It involves definin

achievement...

e problem—in business, industry, science, or gov-nment; specifying the steps which the computer ust execute to arrive at the desired result; and sting the finished program. (Bachelor's or Mas-r's Degree—preferably in Mathematics, Science, ngineering, or Business Administration.)

esearch: Basic research covering a broad spec-um of activity will be expanding at IBM in such eas as mathematics, physics, mechanics, optics, olid state phenomena, chemistry, information eory, machine organization. (An advanced degree Physics, Mathematics, Physical Chemistry, Engi-eering, or Engineering Science.)

asic information about IBM. Across-ne-country operations. Laboratory and manufac-uring facilities are located in Endicott, Kingston, wego, Poughkeepsie, and Yorktown, N. Y.; Be-esda, Md.; Burlington, Vt.; Lexington, Ky.; San ose, Calif.; and Rochester, Minn. Corporate offices re in New York City, with sales and service offices 180 cities throughout the nation.

The accent is on the individual. Each IBM employee is given all the responsibility he can handle and all the support he needs to do his job. Advancement is by merit. IBM is an Equal Opportunity Employer.

Broad education programs. To keep men abreast of new developments in their fields, education programs include on-site courses, advanced-degree courses at universities near IBM facilities, and competitive, full-time scholarships leading to M.S. or Ph.D. Degrees at a university of the employee's choice.

IBM's expansion has come through continuous innovation and through new ideas and products. It makes IBM an exciting place to work and learn. It also offers the kind of responsibility that leads to rapid advancement. There's room for achievement with a growth company like IBM. Please write, outlining your interests, and we will be glad to send you information and brochures. **Manager of College Relations, IBM Corporation, Dept. 915, 590 Madison Avenue, New York 22, N. Y.**

IBM®

TWO NEW CENTERS FOR DIRECT INTERACTION WITH INDUSTRY

The production of consumer goods in the United States has traditionally been the principal concern of industry. Before World War II manufacturing did not require strong support from basic research, nor did it require a large number of engineers with education beyond the bachelor's degree. Products and production techniques changed only slowly as a new research development gradually found its way from the laboratory to the commercial product. But now that picture, as every engineering student knows, has changed.

In the past twenty years, the time between the discovery of new products and their application has grown much shorter. A far larger research effort has been combined with faster development schedules designed to get research knowledge into the final product as rapidly as possible. This acceleration has posed a new set of problems for industry, problems that might be grouped into three categories.

First, the new emphasis on research requires a closer working relationship between basic research groups in the universities and the applied research and development associated with industrial firms. To remain in the forefront, industry must support research more fully and concern itself more directly with the results. Likewise, for outstanding up-to-date educational programs, universities must keep informed about new developments and new discoveries in production and all other fields of endeavor. With the present emphasis on new devices and techniques, today's laboratory curiosity may well be tomorrow's product —witness, the transistor.

Second, industry must enhance its ability to attract and hold top technical and scientific minds. To be effective, research and development require creative minds of the highest caliber. Industry cannot fall into routine patterns if it is to get the new ideas that it needs to remain competitive. The presence of university research organizations, working closely with industry, provides a powerful magnet to attract creative people. The academic community can provide a valuable nucleus around which a stimulating and creative environment can be developed.

Finally, engineers in industry have an increasing need to continually update their technical knowledge to keep pace with new developments. A university can help to meet this need through extension courses, short courses, conferences, and its regular academic program. In addition, universities can encourage engineers from industry to come to the campus for seminars and other engineering campus events.

The University of Illinois College of Engineering has provided support for industry in a number of ways for many years, including research, consultation, qualified engineering manpower, and continuing interaction with industry to make the University's resources and facilities fully available in the most effective way possible.

Now new mechanisms have been or are being developed by the University and the College to facilitate such interactions with the industrial community. Two of these, approved by the Board of Trustees earlier this year, are the Midwest Electronics Research Center and the Production Engineering Educational and Research Center.

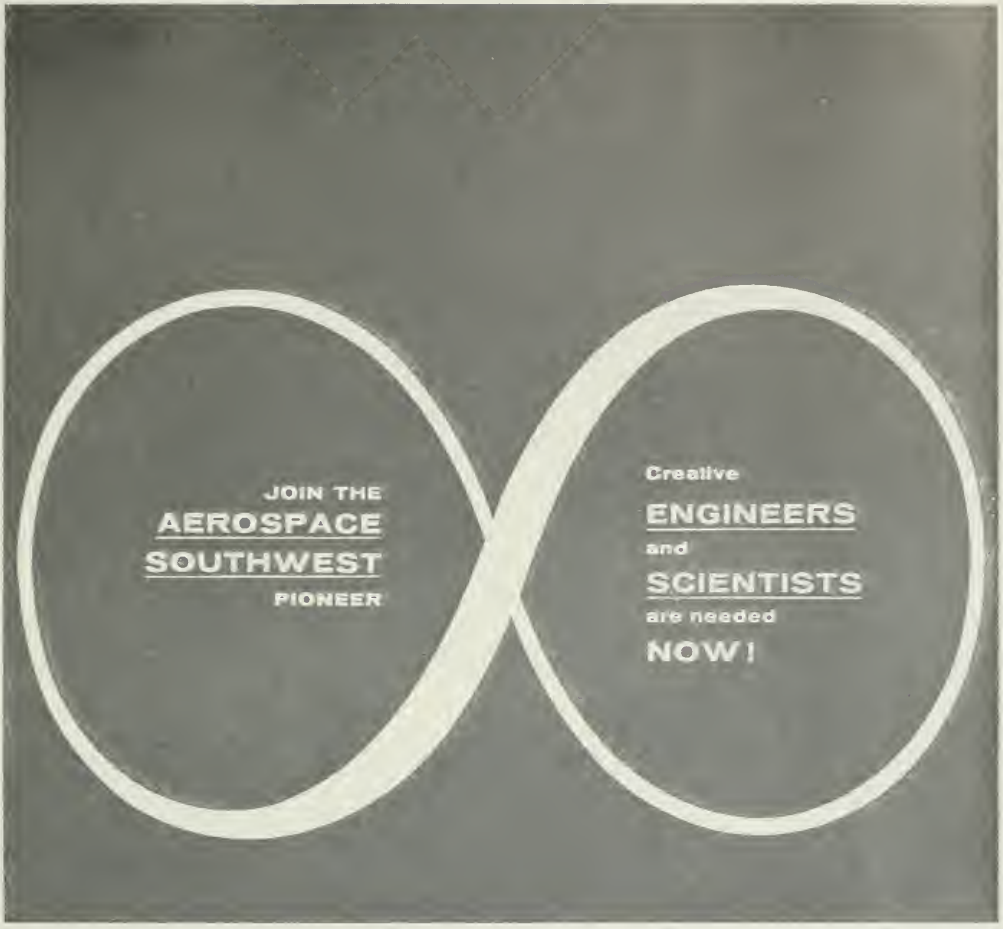
PEERC

A machinist used to finish his day with a basket of chips and a teacup full of broken or worn out cutting tools; since the introduction of modern superhard alloys, he sometimes gets a basket full of tools and a teacup full of chips. This is only one of the many problems that are costing the machine tool industries and their consumers many billions of dollars each year. Such problems will be the major interests of a new educational and research center established on the University of Illinois campus in 1963.

PEERC, or Production Engineering Educational and Research Center, is an interdisciplinary effort sponsored and organized through the participation of the Departments of Mechanical and Industrial Engineering; Electrical Engineering; Mining, Metallurgy, and Petroleum Engineering; General Engineering; Theoretical and Applied Mechanics; the Coordinated Science Laboratory; the Department of Economics of the College of Commerce; and the Engineering Experiment Station.

Some of the many aspects of production engineering with which PEERC will concern itself are machine tool engineering, metal processing, mechanization, automation and control engineering, tool and manufacturing engineering, and processing systems engineering. The activities of the Center will include the development of a graduate educational program, the strengthening of current research areas, the opening of new research areas, the evaluation of foreign developments, the development of an inclusive library, and the dissemination of its findings through short courses and symposia, lectures,

Continued on p. 23, col. 1.



GD/FW is currently engaged in many outstanding projects involving atmospheric and space vehicles and systems. Energetic, creative engineers and scientists are needed now, to help solve the intriguing problems involved in our many ambitious programs. ■ To take advantage of the opportunities offered, contact your Placement Director, to determine when a General Dynamics/Fort Worth representative will be on campus, or write Mr. J. B. Ellis, Industrial Relations Administrator-Engineering, General Dynamics/Fort Worth, P. O. Box 748, Fort Worth, Texas. An equal opportunity employer.

GD/FW AEROSPACE SOUTHWEST PIONEER

GENERAL DYNAMICS | FORT WORTH

Opportunities at Hughes for EE's—Physicists—Scientists:

from the ocean floor to the moon...and beyond

Hughes sphere of activity extends from the far reaches of outer space to the bottom of the sea... includes advanced studies, research, design, development and production on projects such as: ① **SURVEYOR**—unmanned, soft-landing lunar spacecraft for chemical and visual analysis of the moon's surface; ② **SYNCOM** (Synchronous-orbit Communications Satellite)—provides world-wide communications with only three satellites; ③ **F-111B PHOENIX** Missile System—an advanced weapon system designed to radically extend the defensive strike capability of supersonic aircraft; ④ **Anti-ICBM Defense Systems**—designed to locate, intercept and destroy attacking enemy ballistic missiles in flight; ⑤ **Air Defense Control Systems**—border-to-border control of air defenses from a single command center—combines 3D radar, real-time computer technology and display systems within a flexible communications network; ⑥ **3D Radar**—ground and ship-based systems give simultaneous height, range and bearing data—now in service on the nuclear-powered U.S.S. Enterprise; ⑦ **POLARIS** Guidance System—guidance components for the long-range POLARIS missile; ⑧ **Hydrospace**—advanced sonar and other anti-submarine warfare systems.

Other responsible assignments include: *TOW* wire-guided anti-tank missile, *VATE* automatic check-out equipment, Hard Point defense systems.... R & D work on *ion* engines, advanced *infrared* systems, associative computers, *lasers, plasma* physics, *nuclear* electronics, *communications* systems, microwave tubes, parametric *amplifiers, solid state* materials and devices... *and many others.*

B.S., M.S. and Ph.D. Candidates
Members of our staff will conduct

CAMPUS INTERVIEWS

November 6 & 7, 1963

Learn more about opportunities at Hughes, our educational programs, and the extra benefits Southern California living offers. For interview appointment and literature, consult your College Placement Director. *Or write: College Placement Office, Hughes Aircraft Company, P. O. Box 90515, Los Angeles 9, California.*

Creating a new world with electronics

HUGHES

HUGHES AIRCRAFT COMPANY

U. S. CITIZENSHIP REQUIRED

An equal opportunity employer.

Two New Centers

(continued from page 20)

conferences, and interpretive publications.

MERC

Back in the golden age of the Greeks the principle of reaction turbines was demonstrated; but many hundreds of years passed before the modern steam turbine was developed. In 1948 Dr. John Bardeen and two colleagues discovered the transistor; within four years it was the basis of a multi-million dollar industry. How narrow will the gap between discovery and application be tomorrow?

Every industrial organization approaches this problem in its own way —but it is generally recognized that organizational leadership and prosperity in a rapidly evolving technology depend on developing closer relationships between the discovery of new knowledge and the means of applying it.

An antidote for the narrowing gap between discovery and application in the electronics industry has been conceived by Dr. John Bardeen, electrical engineer and physicist at the University of Illinois. This modern approach to the problem, the Midwest Electronics Research Center, is designed to assist electronics firms in handling the complex research required for military and space problems, new areas of civilian technology, and new product development.

The Midwest Electronics Research Center is a flexible organization capable of quickly devising new procedures to solve unusual problems, but it contains a number of established programs calculated to aid electronic industries in keeping up with (or ahead of) their fields. These programs include:

- Applications Forums and Seminars
- Cooperative Industry-University Research Programs
- Consultantship Arrangements
- Continuing Educational and Professional Development Programs
- Interpretive Literature Publication and Distribution Activities
- Joint Industry-Wide Laboratories

In addition, MERC sponsors a Visiting Industrial Associates Program, which permits technical personnel from industry to participate in on-going research programs on the College of Engineering campus at Urbana. Participation in MERC activities by an industry man carries with it a cooperate membership arrangement that facilitates the use of existing mechanisms and the establishment of new means of cooperative efforts.

The Center is a catalyst in the creative idea development process at all levels. It provides direct assistance to industrial firms as they seek to increase their own research potential, and it helps stimulate basic research by University staff members on problems of interest to industry. In this way it is a mutually beneficial program: it encourages a combination of rapid response time of industry with the breadth and depth of the University's talents and facilities. This wide scope of University activities is clearly seen in such diverse interdisciplinary research programs as the Coordinated Science and Materials Research Laboratories, as well as the multi-faceted research activities of the Electrical Engineering and Physics Departments. The Center, as a coordinating agency, establishes the tie between the idea, the pilot model, and the product.

Engineering Departmental Reports and Theses, 1962

This new publication contains bibliographic data and abstracts of research reports published by departments in the University of Illinois College of Engineering during the 1961-62 fiscal year. The bibliography provides information about papers written by the research staff which may not be available except as departmental publications. Titles, authors, and advisors are presented for master's theses and doctoral dissertations.

Engineering Departmental Reports and Theses, 1962, Engineering Experiment Station Circular 77, is available free of charge from the Engineering Publications Office.

THESE GRADUATES THRIVE ON CREATIVE CHALLENGES...THEY'RE

PROJECT MANAGEMENT
V. H. Simson
Iowa State University—BSEE—1948

MANUFACTURING ENGINEERING
R. A. Busby
University of Michigan—BSME—1952

DEVELOPMENT ENGINEERING
R. P. Potter
University of Illinois—BSME—1959

There's an exciting challenge ahead for you,

K. M. Nelson, Manager—Industrial Control Sales, discusses the functioning of Cutler-Hammer's automation teams, and how creative graduates contribute to pioneering developments.

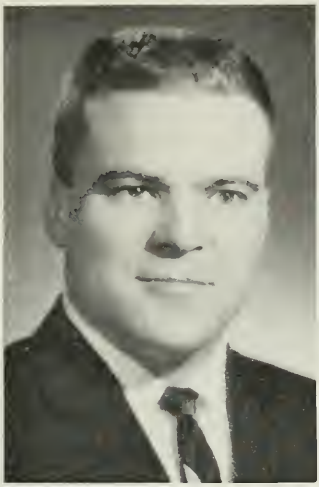
For over sixty years Cutler-Hammer has been a key contributor in planning automatic systems—now called automation.

To meet the pressing challenge of rapidly expanding industrial automation, we have formed a number of automation project teams. These teams combine the technical and manufacturing talents of versatile, seasoned specialists and young, creative-minded engineering and business administration graduates.

Their primary job: to make sure that a customer's automation investment pays an adequate return.

How do they meet this challenge? By working with customer engineers and consultants to isolate cost problems in manufacturing and warehousing operations. Then, by applying their individual disciplines and creative ingenuity to build common-

AUTOMATION PROBLEM SOLVERS



CONTROL ENGINEERING
B. O. Rae
University of Wisconsin—BSEE—1957

SALES ENGINEERING
J. B. Hewitt
University of Colorado—BSME—1957

ANALYTICAL ACCOUNTING
D. R. King
University of Wisconsin—BBA—1957

too, on a Cutler-Hammer automation team

sense automation proposals that can be justified economically.

Automation teams work together in a modern 500,000 square foot plant specifically designed to house every activity involved in the evolution of a system . . . in a creative climate that is conducive to imaginative planning and development.

This approach has paid off! Though industry has barely scratched the surface of the automation potential, our credentials already are quite impressive. Jobs such as the U.S. Post Office mail handling systems in 14 major cities; a pallet handling system for a mail-order firm; data accumulation systems for large steel producers; a number of automobile body-line systems; bundle-handling systems for 30 major newspaper mail rooms; and a package-handling system for a prominent publisher are just a few examples of our automation planning skill at work.

What are the advantages to the young, creative-minded graduate? Short range, it's an exceptional opportunity for the man who responds to the challenge of finding new solutions to tough manufacturing problems. Long range, being a key member of a Cutler-Hammer automation team is an excellent way to get the diversified experience so essential to steady career development and future advancement.

Want to know more? Write today to T. B. Jochem, Cutler-Hammer, Milwaukee, Wisconsin for complete information. And, plan to meet with our representative when he visits your campus.

CUTLER-HAMMER
AN EQUAL OPPORTUNITY EMPLOYER

WHAT'S NEW? ASK...

CUTLER-HAMMER

Cutler-Hammer Inc., Milwaukee, Wisconsin • Divisions: AIL; Mullenbach; Thayer Scale • Subsidiaries: Uni-Bus., Inc.: Cutler-Hammer International, C. A. Associates: Cutler-Hammer Canada, Ltd.: Cutler-Hammer, Mexicana, S. A.

CONTROL

ENGINEERING SOCIETIES CALENDAR

Even though our Professional Societies Editor, Bill Lueck, did his best to contact the various societies, all could not be reached for the first issue of TECH. Leaders of each student Professional Engineering Society are requested to prepare a list of their activities for the coming months and submit it to the TECH office, 48 E.E.B., by the fifteenth of each month. Meeting dates, places, times, probable agenda, and other pertinent information should be included. For further information, contact Bill at the TECH office or 332-1836.

SOCIETY	MEETING	LOCATION	AGENDA	FUTURE PLANS
AMERICAN CERAMIC SOCIETY	October 29	Not determined.	Talk by a representative of the aerospace industry.	Special plans are being made to attract freshmen and sophomores. Speakers from industry will speak on a wide range of topics, both technical and non-technical in nature.
AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS	October 17, 7:30 P.M.	Agricultural Engineering Building	Not definitely determined.	Speakers will talk on topics related to Agricultural Engineering, and a prominent person in the field of public relations will speak at one meeting.
SOCIETY OF WOMEN ENGINEERS (SWE)	October 15, 3rd Tuesday of each month.	141 EEB		Monthly speakers will inform the girls of positions and responsibilities they can expect as woman engineers.
AMERICAN INSTITUTE OF INDUSTRIAL ENGINEERS (AIIE)	November 6, 7:30 P.M.	253 MEB	Warren Beardsly of the Reynolds Metals Co. will speak on "Facility Expenditures." Refreshments will be served.	AIIE plans to have industrial speakers from all fields of engineering along with a combined student-adult chapter meeting, a plant tour, dinner-dance, bowling and golf tournaments, and a picnic.
AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)	Tuesday, November 5	Room 279, South Illini Union	Dr. Ralph E. Peck, professor of Foundation Engineering at Illinois, will speak. Dr. Peck is a national director of the ASCE and will speak on the relationship of the student to the ASCE.	The ASCE plans to sponsor the coffee hour immediately preceding the Civil Engineering Awards Convocation, further promote the enlightenment of its members with the various facets and interesting happenings within the field, and stimulate greater participation in the membership, activities, and planning of the society.
MINERAL INDUSTRIES SOCIETY (MIS)	October 8, 7:30 P.M.	220 Talbot Lab	Professor T. A. Read, head of the Department of Metallurgical, Mining, and Petroleum Engineering, will speak about MIS—the society as a whole and its procedures and objectives. Plans to visit several plants including a steel mill will be made.	Student-staff relationships will try to be improved with such activities as bowling and picnics.
AMERICAN NUCLEAR SOCIETY	Not yet scheduled.	Not determined.	Not determined.	This year the ANS will bring at least six well-known men to the U of I, including scientists from the Argonne National Laboratory and Westinghouse. Several social functions are planned for the year, including the traditional Spring Beer Bust.
ILLINOIS SOCIETY OF PROFESSIONAL ENGINEERS	Wednesday, October 16, 7:00 P.M.	275 Illini Union, South	A color movie by Bell Telephone on the establishment of the DEW Line will be presented to show the cooperation of several branches of engineering. Engineers who were actually at the DEW Line will be at the meeting to answer questions.	Discussions at this year's meetings will concentrate on the professional side of engineering. Such topics as labor unions, professional ethics, and professional registration will be presented.
	Wednesday, November 13, 7:00 P.M.	275 Illini Union, South	Not determined.	
	Wednesday, December 11, 7:00 P.M.	275 Illini Union, South	Not determined.	
	Adult Society: first & third Thursday of each month.			
	State Board of Directors: November 1 & 2	Champaign	Opportunity for professional contact with practicing engineers.	
AMERICAN FOUNDRYMAN'S SOCIETY	Field trip, Monday, November 4, 1:00 P.M.	Contact Tom Degenhart, 176 Snyder, MRH	General inspection of the Caterpillar Tractor Co. foundry in Peoria, Ill. Following the tour the group will attend a chapter meeting of the national AFS in Peoria, receive a free dinner, and meet many prominent foundry officials in the Peoria area	One trip is planned each semester to acquaint engineering students with commercial foundries, and to correlate their course work with actual foundry practice.
AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS (AIAA)	Mid-October a specific date has not been set.	Not determined.	Lecture by leading representative of an aircraft company.	
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS				Guest speakers from industry and research groups will be featured at the monthly meetings. Other events include: Sponsoring Engineering Open House, Industrial field trips, senior banquet, and promoting closer student-faculty relations.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS	November 20, 7:30 P.M.	Room 269, Illini Union	Speaker from NASA Manned Space Flight Center; Business meeting; refreshments.	Weekly movies on diverse engineering fields October 16, 23, & 30; November 6 & 13; and December 4 & 11. To be shown at 9:00 P.M. in room 253 MEB.
	December 18, 7:30 P.M.	Room 273 Illini Union	Speaker, business meeting, and refreshments.	
	January 7, 7:30 P.M.	Room 273, Illini Union	Business meeting and election of officers.	
INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)	October 16, 8:15 P.M.	151 EEB	A speaker from the Motorola Military Electronics Division will be present.	The IEEE is planning a tour of the Magnavox plant in Urbana, which is engaged in a number of military projects. Definite time, date, and transportation arrangements will be announced later.
	November 5, 7:30 P.M.	151 EEB	A representative from the NASA Lewis Research Center will speak.	

Tom Thomsen wanted challenging work

He found it at Western Electric

T. R. Thomsen, B.S.M.E., University of Nebraska, '58, came to Western Electric for several reasons. Important to him was the fact that our young engineers play vital roles right from the start, working on exciting engineering projects in communications including: electronic switching, thin film circuitry, microwave systems and optical masers.

The wide variety of Western Electric's challenging assignments appealed to Tom, as did the idea of advanced study through full-time graduate engineering training, numerous management courses and a company-paid Tuition Refund Plan.

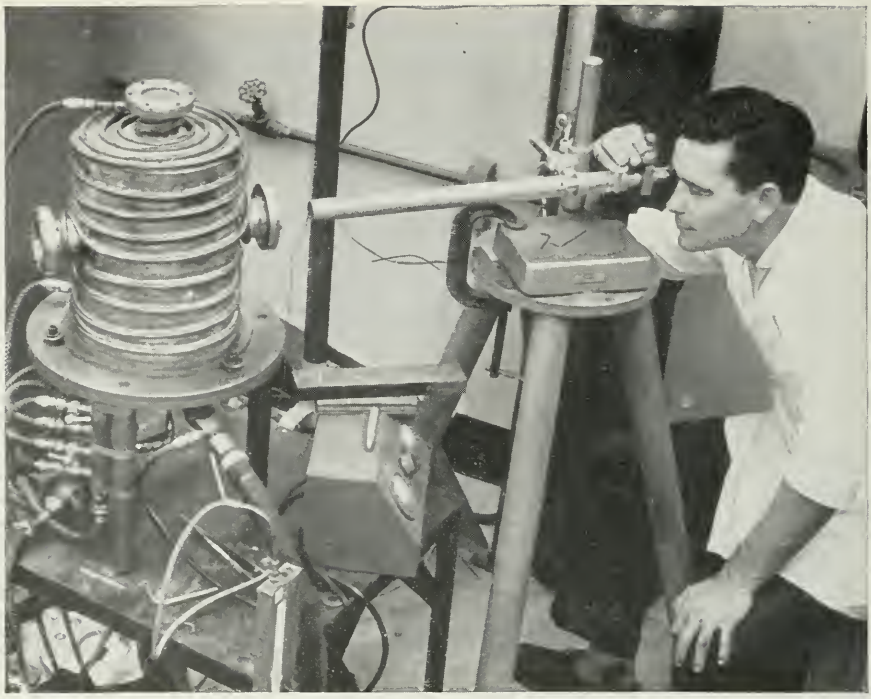
Tom knows, too, that we'll need several thousand experienced engineers for supervisory positions within the next few years. And he's getting the solid experience needed to qualify. Right now, Tom is developing new and improved inspection and process control techniques to reduce manufacturing costs of telephone switching equipment. Tom is sure that Western Electric is the right place for him. What about you?

If you set the highest standards for yourself, enjoy a challenge, and have the qualifications we're looking for—we want to talk to you! Opportunities for fast-moving careers exist now for electrical, mechanical and industrial engineers, and also for physical science, liberal arts and business majors. For more detailed information, get your copy of the Western Electric Career Opportunities booklet from your Placement Officer. Or write: Western Electric Company, Room 6405, 222 Broadway, New York 38, N. Y. And be sure to arrange for a personal interview when the Bell System recruiting team visits your campus.

Western Electric MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

AN EQUAL OPPORTUNITY EMPLOYER

Principal manufacturing locations in 13 cities • Operating centers in many of these same cities plus 36 others throughout the U. S. • Engineering Research Center, Princeton, New Jersey • Teletype Corporation, Skokie, Illinois, Little Rock, Arkansas • General headquarters, 195 Broadway, New York 7, New York



Picture of a man in love!

Young engineers seldom fall in love with corporations.

But they *do* fall in love with their own work—when they're given the opportunity to put their own best ideas into action.

We are seeing these young men in increasing numbers at International Harvester . . . men of many talents who come to us because of our unique and growing variety of independent engineering assignments.

Mechanical, industrial, agricultural, chemical, ceramic, metallurgical, general and civil engineers . . . mathematicians, computer technologists, program analysts . . . these are the types of graduates we need now for work in the design, development, engineering and testing of *more than a thousand different products in nine separate engineering and research centers.*

International Harvester serves three basic industries: transportation, construction and agriculture. World-wide, the Company is the largest producer of heavy-duty trucks as well as farm equipment. International Harvester is a leader in construction and earthmoving equipment, a major steel producer and, through its Solar facility, a pioneer in gas turbine development.

With an eye to still further progress, we have *doubled* our research and engineering expenditures in the past ten years—and they are still growing!

International Harvester Company

An Equal Opportunity Employer

New booklet describes our engineering and research centers. For your copy, mail this coupon to: General Supervisor of Employment, International Harvester Company, 180 N. Michigan Avenue, Chicago 1, Ill.

AN INTERNATIONAL HARVESTER REPRESENTATIVE WILL BE ON YOUR CAMPUS SOON. IF YOU WOULD LIKE A PERSONAL INTERVIEW, PLEASE CHECK HERE ☐

NAME_____ *(Please Print)*

ADDRESS_____

CITY_____ STATE_____

MAJOR_____

SCHOOL_____

YEAR GRADUATING_____

Dear Joe,

I hope you will forgive my initial response when you asked me to be the October Technocutie—and thanks to the passer-by who revived me with his smelling salts. I only hope I didn't sniff too much . . . He certainly looked as if he needed them for his bourbonology class!

When you called and asked me to jot down my activities and other "oddities," I suddenly felt alone in a climate of "what do I do?" Well, Joe, I've been on campus and a Gamma Phi Beta for two semesters; I'm majoring in secretarial training (minoring in law); and my home town is Berwyn, Illinois, a suburb of Chicago. I haven't participated in many activities during my two semesters, but in case you need the information I've been active on the Illio, *International Fair, Nite Lites, Mom's Day Council, and a participant in the Dolphin Show (Queen Contest). I know it isn't much but I hope to do more this year.*

This summer I worked as a secretary for Kelburn Engineering Co. in Chicago. In case you are curious, they manufacture timing devices for electrical equipment (how interesting).

Before I close, Joe
There's a little something I want you to know
It's been such a ball
Just posing for pictures and all
(Just to let you know that I write poetry on the side—Egad!)

Sharon Trappina

Ed. . . . The repair department at Kelburn says Sharon is ticking fine, but in case you don't trust their diagnosis . . . . . see you at Gamma Phi!

Ultra-modern Research & Engineering Center
at Delco Radio, Kokomo, Indiana

To Continue To Learn And Grow . . .

. . . is a basic management philosophy at Delco Radio Division, General Motors Corporation. Since its inception in 1936, Delco Radio has continually expanded and improved its managerial skills, research facilities, and scientific and engineering team.

At Delco Radio, the college graduate is encouraged to maintain and broaden his knowledge and skills through continued education. Toward this purpose, Delco maintains a Tuition Refund Program. Designed to fit the individual, the plan makes it possible for an eligible employe to be reimbursed for tuition costs of spare time courses studied at the university or college level. Both Indiana University and Purdue University offer educational programs in Kokomo. In-plant graduate training programs are maintained through the off-campus facilities of Purdue University and available to employes through the popular Tuition Refund Program.

College graduates will find exciting and challenging programs in the development of germanium and silicon devices, ferrites, solid state diffusion, creative packaging of semiconductor products, development of laboratory equipment, reliability techniques, and applications and manufacturing engineering.

If your interests and qualifications lie in any of these areas, you're invited to write for our brochure detailing the opportunities to share in forging the future of electronics with this outstanding Delco-GM team. Watch for Delco interview dates on your campus, or write to Mr. C. D. Longshore, Dept. 135A, Delco Radio Division, General Motors Corporation, Kokomo, Indiana.

An equal opportunity employer

solid state electronics

DELCO RADIO DIVISION OF GENERAL MOTORS

KOKOMO, INDIANA

We cool an astronaut with 100 times less power than it takes to air condition your car

It takes an average of 7 horsepower to air condition an automobile. You'd think the complexities of keeping an astronaut cool and comfortable would require at least as much power. But Garrett-AiResearch designed and built a system that requires about the same energy as a 60-watt light bulb. And that's important in space, where power is at a premium. □ The Garrett system takes advantage of the low boiling point of water in space to absorb heat from the astronaut's space suit and spacecraft. The system is tiny, lightweight, and works in zero gravity. □ This remarkable cooling unit is part of the entire environmental control system which Garrett supplies for the NASA-McDonnell Project Mercury missions. It not only cools, but provides and circulates oxygen, controls pressure, and removes carbon dioxide, water vapor and odors. □ For further information about many interesting project areas and career opportunities at The Garrett Corporation, write to Mr. G. D. Bradley at 9851 S. Sepulveda Blvd., Los Angeles. Garrett is an equal opportunity employer.

THE FUTURE IS BUILDING NOW AT GARRETT

Los Angeles — Phoenix

A DECADE OF ACHIEVEMENT IN INDIA

This article, from the Engineering Publication Office, first appeared in the September *ASEE International Newsletter*.

This year marks the tenth anniversary of a new era in engineering education in India. In 1953 the University of Illinois became involved in discussions about an assistance program for the Indian Institute of Technology at Kharagpur, West Bengal. IIT Kharagpur, founded in 1952, was the first engineering college established by the Indian National Government. Through the United Nations-sponsored negotiations an assistance program was established with the U. S. International Cooperation Administration, and in 1954 the first contingent of University of Illinois professors arrived at Kharagpur and went to work.

IIT Kharagpur has become the outstanding engineering school in India. Assistance of University of Illinois professors under contracts of the ICA and its successor, the Agency for International Development, has played a significant part in this success. Over the years the University of Illinois has served as purchasing agent for 1½ million dollars worth of equipment purchased by the U. S. Government agencies. More than a score of University of Illinois professors have been at the Institute, both as full-time members of the staff and as visitors making executive inspections and giving lectures and seminars. Hundreds of Indian students and faculty members have been brought to America to study in their respective fields of engineering and to learn American methods of teaching before returning to India. Approximately 80% of the students who came attended the University of Illinois.

Today IIT Kharagpur is a progressive engineering school with 1580 undergraduate students and 287 graduate students. The school is strong in research and graduate training. Last year it granted 20 Ph.D.'s, 1 D.Sc., and 165 Master's degrees, in addition to nearly 400 undergraduate degrees.

Impravisian is essential in vast areas of India isolated fram supplies af canventianal faundry materials and equipment. Above, Professar James L. Leach af the Mechanical and Industrial Engineering Department shaws faundry apprentice trainees at the Indian Institute af Technology at Kharagpur haw ta dry a mald and care using a wood fire when they have na drying aven. Professar Leach is ane af many University af Illinais faculty members wha have worked at Kharagpur over the last ten years.

Of the 287 students doing graduate work, 69 were Research Scholars and Fellows, 41 were teachers trainees, and the remaining 177 were post-graduate students. The success of the Institute has caused four other similar institutions to be started in India, none of which are more than four years old. The Institute at Kharagpur has served as a model for the other schools.

In addition to its large graduate program, the Institute is well known for its outstanding research programs and its use of the American system of teaching and evaluating student accomplishments. Examples of current research projects being directed by University of Illinois professors are the development of a smokeless furnace for high-ash-content India coal, a smokeless locomotive engine, a computer program, and a central instrumentation services center as a model for all India. The American system of teaching and grading, which is very much different from the Indian system, includes giving exams every term and grading on the letter-grade basis. The other Institutes of Technology in the country have copied this system. The Kharagpur IIT is also known throughout India for its excellent agricultural engineering program, which was developed under the direction of U. of I. Professor Ralph C. Hay.

Professor Hay's work is unique because he organized the first agricultural engineering department in India. He designed the building, organized a staff of teachers, and trained them for their work. He made a great contribution to the establishment of an agricultural engineering program that is considered second to none in India, primarily because it was specifically designed to study and solve Indian agricultural problems. IIT Kharagpur is presently the only educational institution in India offering a master's degree in this field.

The University of Illinois has long been active in international educational programs. According to the Institute of International Education in New York City, Illinois ranks third among the states with the most foreign students, the University of Illinois is third among universities with the highest foreign student enrollment, and the University ranks ninth among U. S. institutions with the largest number of faculty members abroad. The work at IIT Kharagpur represents the largest, single international effort the University has made to date.

During the past year, ten University of Illinois faculty members have been at Kharagpur. These men are continuing to build on the achievements of the last ten years—a decade that has seen the foundation laid for modern engineering education in India.

Lifted From *Outlook*

Every once in a while the college's newsletter, *Engineering Outlook*, runs something interesting. When this happens we steal it. How's that for student-staff cooperation? Sometimes to suit our own whims, we make changes—and we haven't been sued yet.

Science, Technology, and Space Navigation

Could Albert be wrong? . . . We may soon know. A new electric vacuum gyro, developed over the last five years in the U of I Coordinated Science Laboratory (C.S.L.), is potentially sensitive enough to prove or disprove Einstein's theory of relativity. According to Einstein's general theory of relativity, the spin axis of a gyroscope moving around the earth should change in direction a few seconds of arc over a year's time. This change is so small that it could not be measured with conventional gyros, which drift much more than that in one day. The new CSL gyro, however, is virtually drift free and studies are now under way concerning the feasibility of putting the electric vacuum gyro in orbit around the earth to attempt such a measurement.

The electric vacuum gyro was invented by Dr. Arnold Nordsieck, who was a U of I faculty member from 1947 to 1961. His concept has been translated into an elegant precision instrument, originally for nautical navigation, by a group of C.S.L. researchers under the leadership of Professor Howard Knoebel. The inherent precision of the instrument promises many applications in the future, including use for space flight navigation.

Basically the gyro consists of a two-inch beryllium ball—balanced and spherical to within a few millionths of an inch—suspended by electric fields in an ultra-high vacuum (about one thousandth of one billionth of atmospheric pressure). This rotor is

The heart of the electric vacuum gyro is the rotor, shown with supporting electrodes and ceramic spacers during assembly into the demountable vacuum housing.

brought up to its rotation speed by induction coils which produce a spinning electrical field. After a few minutes of initial acceleration, the power to the coils is turned off, allowing the ball to "coast," spinning a few thousandths of an inch away from the walls of its chamber. Effectively isolated from the rest of the universe, the rotor will continue spinning for years.

In the laboratory version, two pairs of mutually perpendicular photomicroscopes, which are focused through sapphire windows in the ceramic housing, read position data from a zigzag line etched on the equator of the ball. The entire gyro assembly is placed on a two-axis gimbal which follows the motion of the rotor spin axis. The motion of the gyro relative to the stars can then be measured from the gimbals.

A careful sequence of refining and testing have resulted in excellent performance figures which are continually being improved. Even in its present form, performance is far better than any other gyro being produced. Still better performance is expected when presently planned modifications are introduced. One of these ideas, for example, is the fabrication of a preshaped hollow rotor which becomes perfectly spherical under the natural deformation of high speed rotation. Such modifications will improve the present performance capabilities of the gyro to the point where the incredible accuracy requirements of the relativity experiment in space could be fulfilled.

Friction: A Tool for Welding

Friction is a paradox. While even an engineer couldn't live without it, many of his efforts are spent in trying to overcome it. At the University of Illinois, however, friction is being exploited. In the Department of Mechanical and Industrial Engineering the heat generated by friction between two metal specimens is being used to weld the specimens in a bond as strong as any other weld currently in use.

While the phenomenon of friction is not yet completely understood from a scientific standpoint, the process of friction welding has been used on metals in Russia and on plastics in the United States for several years. Because of the lack of research, however, its application has been severely limited.

Friction welding studies at the University of Illinois are being conducted by Mr. M. B. Singer in the Mechanical

(continued on page 43, column 1)

Engineers

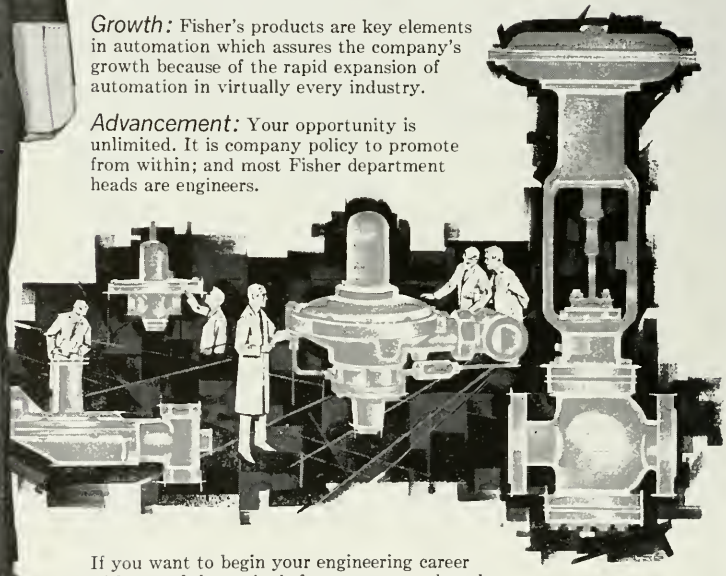
In Choosing a Career, Consider these Advantages—

Location: Fisher is basically an "Engineering" company with 1,500 employees located in a pleasant midwest community of 22,000. It's less than 10 minutes to the Fisher plant from any home in Marshalltown.

Type of work: You'll become a member of an engineering team that has produced some of the outstanding developments in the field of automatic pressure and liquid level controls.

Growth: Fisher's products are key elements in automation which assures the company's growth because of the rapid expansion of automation in virtually every industry.

Advancement: Your opportunity is unlimited. It is company policy to promote from within; and most Fisher department heads are engineers.



If you want to begin your engineering career with one of the nation's foremost research and development departments in the control of fluids, consult your placement office or write directly to Mr. John Mullen, Personnel Director, FISHER GOVERNOR COMPANY, Marshalltown, Ia.

If it flows through pipe anywhere in the world chances are it's controlled by...

FISHER® Controls SINCE 1880

Pardon me if I sound as if the executive position I've landed deals with the whole future of the world.

It does.

Certainly, there's no organization today conducting more vital business than the business of the United States Air Force. And very few organizations that give a college graduate greater opportunities for responsibility and growth.

As an Air Force officer, you'll be a leader on the Aerospace Team—with good pay, a 30-day paid vacation each year, educational opportunities.

How can you get started? For many, the best way is through Air Force ROTC. But if you missed out on AFROTC, or if there's no unit on your campus, you can still apply for Air Force Officer Training School. This three-month course leads to a commission as a second lieutenant in the United States Air Force.

For more information about Air Force OTS, see your local Air Force representative.

U. S. Air Force

The Society Page

Engineering Activities

We hesitated to call this the "Society Page." Society pages are about what people wear on various social occasions and other bits of trivia which do not belong in an engineering publication. On the other hand, several TECHNOGRAPH staff members spent over twenty hours contacting and interviewing officers from various engineering professional societies and Engineering Council; our efforts turned up little but bits of trivia: hence "Society Page." Our conclusion: we aren't quite sure if engineering activities need a sedative or a stimulant.

This page (and other pages . . .) was reserved to report the plans of the engineering societies and their officers . . . plans which *seemingly* do not exist. We say *seemingly* because we are confident Engineering Council and the Professional Societies are in a position to have their most progressive and constructive year. We say this even though the kindest thing we can say about the first Engineering Council meeting is nothing.

Perhaps it is as one professional society president said, "Right now it is a matter of getting my own bearing." This is quite understandable and we are willing to wait . . . until the next TECH issue.

We hope we won't have a meaningless "Society Page" in our next issue. Members of the Professional Societies and other student engineering organizations have indicated an emphatic desire to use TECH to advance their ideas and their plans. We hope we will be able to report real ideas of real people trying to do real things, working together for the benefit of their societies and the student body in general.

If this is not the case by then, we will again have a "Society Page"—with pictures showing what they are wearing these days!

Open House

During our discussions with various engineering activity officers and other students, one thing was unanimous: Every student we talked with indicated a sincere desire to make Engineering Open House something besides the depressing carnival it has been for several years . . . depressing to the college student participant, and a carnival to spectators who get nothing but trivia from it. No concrete ideas were voiced by these students; however, a variety of "hints" were voiced ranging from a central theme to complete elimination of Open House.

Subsequent discussions with various faculty members revealed a similar desire to improve Open House. Mr. David O'Bryant, Chairman of the faculty Open House Exhibits and Tours Committee, remarked that, "A change in Open House is long overdue! Our Committee is prepared to give engineering students and their societies all the assistance, advice, and cooperation possible to change and improve Engineering Open House. Each Committee member is prepared to enlist the aid of other faculty members who will gratefully work with students to change it and make it a worthwhile event."

Students and faculty are obviously agreed a change is long overdue. The question now is how and when. We contend that there is one missing ingredient to constructively change Open House: ideas . . . ideas that have a chance to get out into the open and receive the scrutiny of students and faculty.

These ideas can come from only one place—you, student and faculty. Bring your ideas for changing Open House out into the open; talk them up; and most important, write them down and send them to us so everyone can scrutinize and help incubate them. With everyone's ideas from both sides of the lecturn, we guarantee a change for the better (things can't get any worse!).

G.M.D.

National Electronics Conference
October 28, 29, 30
McCormick Place, Chicago

the doorway to a new world of Electronic Achievement

The Illinois Chapter of the Institute of Electrical and Electronics Engineers is sponsoring a one day trip, October 29, for *all* EE students to attend the largest NEC in history. Special and new product seminars, exhibits and displays, refresher courses, and specially organized programs for university students will give electrical engineering students a preview of the latest challenges and career opportunities offered by the field of electronics. A wide variety of activities ranging from technical papers and audience participation panel discussions to a lecture on "Man's Attempt to Communicate with Other Species" will be a part of the conference.

Engineering Faculty members are urging all students to attend this conference if at all possible. Students planning to attend should call Marvin Rogers (367-2769) or Bill Mayberry (359-1808) after 6 p.m. for specific information concerning transportation, registration, and so forth. *(Ed. . . . Our apologizes to the IEEE for putting their non-trivia article on the "Society Page.")*

An idea grows from one mind to another.

It may begin with nothing important. Just a word. Or a notion. But as each succeeding mind brings a fresh viewpoint, the idea begins to grow and mature.

If you like working in an atmosphere that breeds ideas, you'll like working at Northrop. Stimulating minds and stimulating projects are all a part of the climate here. We have more than 70 active projects in work, and we're constantly evaluating new lines of inquiry. Projects cover such fields as interplanetary navigation and astro-inertial guidance, aerospace deceleration and landing, man-machine and life support systems for space, automatic checkout and failure prediction systems, laminar flow control techniques and world-wide communications.

For more specific information, see your placement counselor. Or write to Dr. Alexander Weir, Northrop Corporation, Beverly Hills, California, and mention your area of special interest.

NORTHROP

AN EQUAL OPPORTUNITY EMPLOYER

WHAT DO YOU KNOW ABOUT CO-OP PROGRAMS?

by Lawrence Heyda

Less than a year ago, I received information concerning a cooperative training program sponsored by MacDonnell Aircraft Corporation of St. Louis, Missouri. After reading their brochure and interviewing with one of their company representatives, I became interested and subsequently joined their co-op program.

Now, having completed one summer's work with the organization, I feel it would benefit other engineers to learn about this program and the unseen advantages which it offers. As their brochure points out, "basically, the cooperative plan is the integration of classroom work and practical industrial experience in an organized program under which college engineering students alternate periods of attendance at college with periods of employment in industry. The student's employment is related to his field of study and his industrial assignments increase in complexity as he progresses through his college curriculum. The rates of pay are on an ascending scale, increasing each academic year and are paid on an hourly basis for a forty-hour work week during the scheduled in-plant assignments." The entire program extends the normal four-year curriculum to only five years.

A co-op program offers many advantages but these advantages often pass unnoticed before the analytical eyes of many engineering students. I shall therefore describe some of them in the hope that you will investigate further if you feel such a program is for you. Remember that many of the opportunities which this particular program offers are also a part of other co-op programs.

Larry is enrolled in the five year program combining Mechanical Engineering and English majors. He is a sophomore and has spent one summer working for MacDonnell under their co-op program.

Co-op Advantages

Foremost in every student's mind is the subject of money—the funds he needs each semester to finance his college education. MacDonnell co-op students work every other semester and earn enough money to finance a full semester at the University of Illinois. To be specific, my salary this summer was $1.93 per hour and it will increase by ten cents each time I return for a new work session. For an average twelve-week work period, the wages total $926.40 before taxes.

A second big advantage of this type of program is the year of industrial experience students obtain while attending college. As a result the student obtains two benefits: valuable industrial education and an opportunity for a higher starting salary when he graduates. Industrial co-op programs, such as MacDonnell's, are also highly respected by other industries across the country who are eager to hire graduates of the program.

Another important student benefit is the opportunity he has to explore in industry the areas of engineering in which he may specialize after graduation. MacDonnell's plan allows students to work in any or all major areas of their company: manufacturing and service, engineering design and analysis, and engineering laboratory operations. Thus the co-op student obtains a wide view of current competitive industry and a background from which he can choose his field with a broader understanding of other areas.

These are the advantages which most co-op programs provide. In particular, my stay at MacDonnell gave me an additional benefit which I had not previously anticipated. Since MacDonnell is responsible for Mercury, Gemini, and other government space projects, I returned to classes feeling that I had done my own small part in furthering the free world's progress toward peace and the conquest of space.

This cooperative plan and similar ones have much to offer. Why not look into them yourself? Regardless of whether you decide positively or negatively, your time will not be wasted. If you are in high school, application can be made through your high school counselor. If you are a U of I student watch for co-op program notices on the bulletin boards. You may find, as I did, that the program ideally fits your needs.

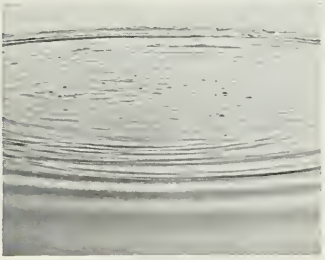
FROM THE LAUNCHING TO THE TARGET, EVERY MAJOR U. S. MISSILE DEPENDS UPON SYSTEMS, SUB-SYSTEMS OR COMPONENTS DESIGNED, DEVELOPED OR PRODUCED BY BENDIX TALENTS

FOUR OF THE U.S. SPACE DETECTIVES THAT SPOT, SHADOW AND REPORT ON EVERY MAN-LAUNCHED OBJECT IN OUTER SPACE DEPEND ON EQUIPMENT OR TECHNICIANS, OR BOTH, SUPPLIED BY BENDIX

AT TAKE-OFF, IN THE AIR, ON LANDING . . . WHENEVER MAN FLIES, IT'S LIKELY BENDIX EQUIPMENT MAKES HIS TRIP SMOOTHER, SAFER. BENDIX HAS LOGGED MORE FLIGHT TIME THAN ANY NAME IN AVIATION

EVERY TIME YOU BRAKE YOUR CAR, CHANCES ARE YOU DEPEND UPON BENDIX. SINCE 1924 BENDIX HAS DESIGNED AND BUILT MORE BRAKES FOR MORE DIFFERENT VEHICLES THAN ANY OTHER PRODUCER

TODAY, AUTOMATED TAPE-CONTROLLED MANUFACTURING AS DEVELOPED BY BENDIX HELPS TURN BLUEPRINTS INTO FINISHED PRODUCTS, GETS PROTOTYPES INTO PRODUCTION FOUR TIMES FASTER



IN THE CONQUEST OF THE UNKNOWN, BENDIX RESEARCH AND DEVELOPMENT IS EXTENDING MAN'S ABILITY TO COMMUNICATE THROUGH THE OCEAN DEPTHS AS READILY AS THROUGH SPACE

WHEN SPACE TRAVEL BECOMES A REALITY, PILOTS WILL RELY ON DEVICES CONCEIVED AND DEVELOPED BY BENDIX TO NAVIGATE, GUIDE AND STABILIZE THEIR SHIPS, AND RETURN THEM SAFELY TO EARTH

CREATIVE ENGINEERING . . . *Q.E.D.*

The variety of challenges The Bendix Corporation offers the college graduate is practically unlimited. Bendix participates in almost every phase of the space, missile, aviation, electronics, automotive, oceanics and automation fields. We employ top-notch engineers, physicists, and mathematicians for advanced product development to further Bendix leadership in these fields.

Bendix operates 32 divisions and subsidiaries in the United States, and 12 subsidiaries and affiliates in Canada and overseas. Our 1950 sales volume was $210 million. Last year it was over $750 million.

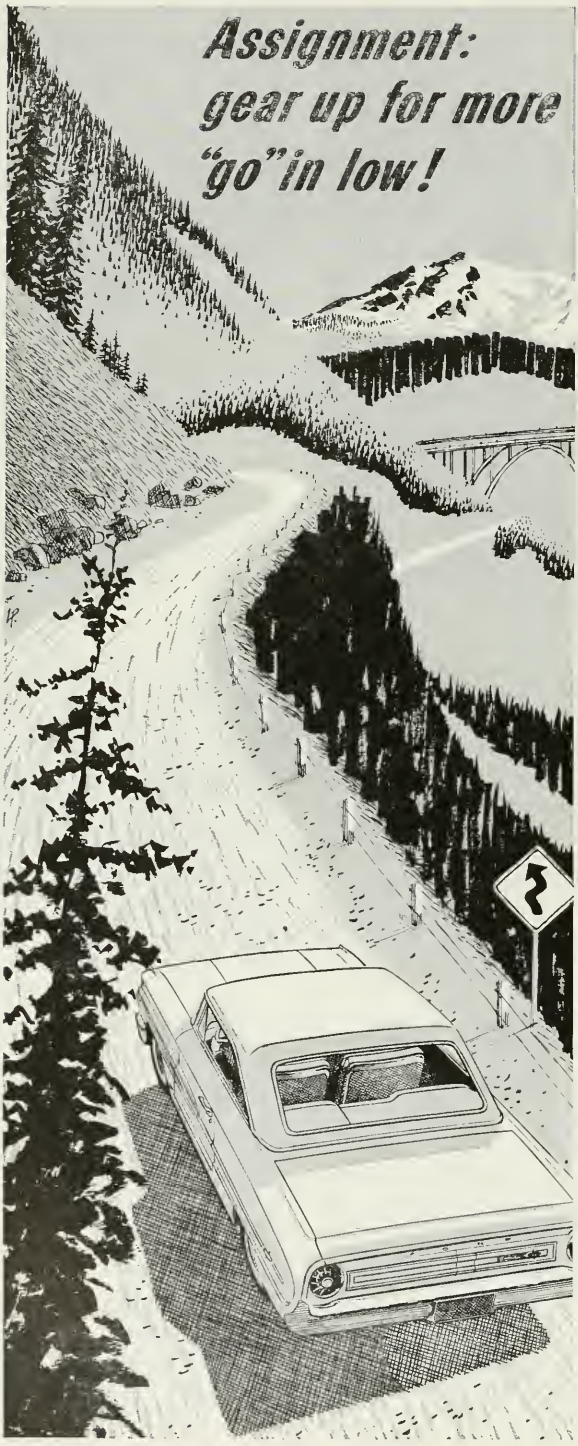
Look over the materials we have in your school's placement office. Talk to our representative when he's on campus. If you'd like a copy of our booklet "Build Your Career to Suit Your Talents," write Dr. A. C. Canfield, Director of University and Scientific Relations, The Bendix Corporation, Fisher Building, Detroit 2, Mich. An equal opportunity employer.

WHERE IDEAS UNLOCK THE FUTURE

THE Bendix CORPORATION

FISHER BUILDING, DETROIT 2, MICH.

THERE ARE BENDIX DIVISIONS IN: CALIFORNIA, MISSOURI, IOWA, OHIO, INDIANA, MICHIGAN, PENNSYLVANIA, NEW YORK, NEW JERSEY, MARYLAND.



Result: All 3-speed manual transmissions in Ford-built cars with V-8's now are fully synchronized in each forward gear

To get more "go" in low, Ford engineers were asked to upgrade the conventional 3-speed transmission to give drivers more control in all three forward gears—to make "low" a driving gear—and they tackled the problem imaginatively.

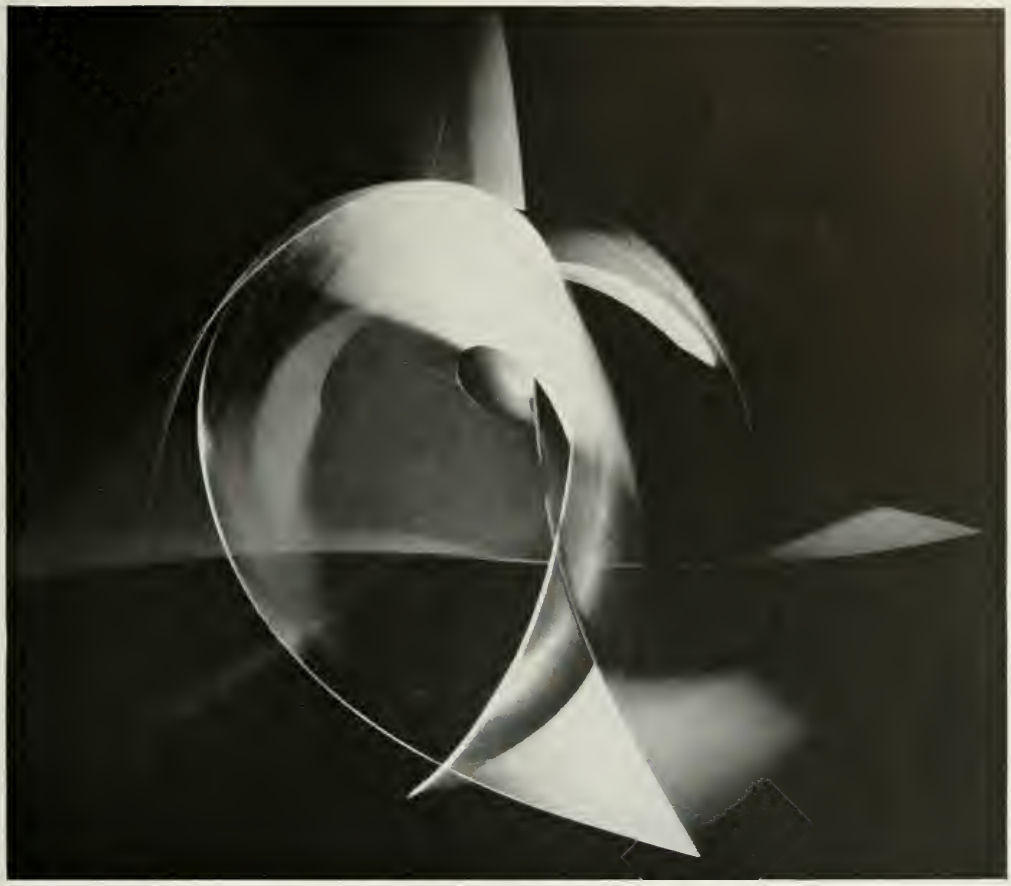
Their achievement, another Ford First, is the only U.S. 3-speed manual transmission with all three forward gears fully synchronized! No need now to come to a complete stop when you shift into low—and no clashing gears! It lets you keep more torque on tap for negotiating sharp turns and steep grades. It makes driving more flexible, more pleasurable.

Another assignment completed and another example of how engineering leadership at Ford provides fresh ideas for the American Road.

Ford

MOTOR COMPANY
The American Road, Dearborn, Michigan
WHERE ENGINEERING LEADERSHIP BRINGS YOU BETTER-BUILT CARS

Shown: 1964 Ford Galaxie 500/XL two-door hardtop



Construction in Blue and Black, Aluminum. José de Rivera. Collection of Whitney Museum of American Art, New York. Motion-study photograph by Herbert Matter

What makes a Company "Modern"?

Not size. Not capital resources. Certainly not age. At Celanese, we believe it is the degree to which a company is equipped to meet the present and future needs of its customers.

Efficient plant. Contemporary product. Aggressive management. Industrious work force. The ability to think ahead of the situation and be ready for the problem when it occurs.

Celanese *happens* to be a young company. Much more important, it's a modern company.

Perhaps you're among the men who will help keep us modern. If you are trained in chemical engineering, electrical engineering, mechanical engineering, chemistry, or physics, we hope you will stop in to see our representative when he visits your campus. Or write directly to us, briefly outlining your background.

Address your correspondence to: Edmond J. Corry, Supervisor of College Relations, Celanese Corporation of America, 522 Fifth Avenue, New York 36, New York. Celanese®

AN EQUAL OPPORTUNITY EMPLOYER

Celanese

CHEMICALS FIBERS POLYMERS PLASTICS

YES NO Would you like to choose from a broad spectrum of openings?

YES NO Would you welcome an early chance to work on whole projects?

YES NO Do you give high priority to fewer steps to the top?

YES NO Is choice of geographical location important to you?

YES NO Do you tend to prefer a formal training program?

YES NO Will employee benefits strongly influence your decision?

YES NO Can you handle the challenges of early responsibility?

YES NO Do you welcome individual attention by management?

YES NO Is job security one of your most important factors?

YES NO Is unlimited growth opportunity an important prerequisite?

Test yourself. Are you a small or large company man?

If you answered "yes" to six or more questions, it indicates that you're strongly attracted by the advantages of *both* large and small companies. If so, you might be especially interested in Babcock & Wilcox, a manufacturer primarily concerned with the conversion and control of energy.

B&W is certainly a large and progressive company. Its 1962 sales, for example, were more than $330 million. And every year, B&W invests millions in research and development. B&W can offer you all the advantages of a large company—training program, wide variety of job openings (17 facilities in 10 states), plus the security and benefits of a large 96-year-old company.

B&W can also be considered a small company. There are 154 larger industrial companies in the U.S. Growth opportunities are enormous. Yet only 60 bachelor-level students will be hired this year. This select group will be given an opportunity to work on important projects at an early stage in their professional careers.

Right now, B&W has challenging job openings for both graduate and undergraduate engineers and scientists, including M.E., E.E., Ch.E., Met.E., Cer.E., Nuc.E., chemists and physicists. For more information, talk to the B&W interviewer when he is on your campus or write to J. W. Andeen for "Your Career Opportunity at Babcock & Wilcox." The Babcock & Wilcox Co., 161 East 42nd Street, New York 17, N. Y.

An equal opportunity employer

Babcock & Wilcox

M. B. Singer, instructor in mechonicol engineering, is shown preporing experimentol equipment for friction welding.

Friction: A Tool for Welding

(continued from page 33)

Engineering Welding Laboratory. Tests have been conducted primarily on low-carbon steels, although a few other materials have been tested. The weld, produced by rotating one specimen while pressing another specimen against it, occurs in four stages: wear in, preheat, constant heat, and upset. The whole process takes less than four seconds for a ½-inch-diameter specimen, and can be achieved using a modified lathe. Less power is consumed by this system than by arc or resistance welding, and no special equipment is needed to weld many dissimilar metals. Further, there is no contamination from the heat source, and studies of welding environments are feasible.

One of the current questions being considered in this project concerns the welding of malleable iron, which loses its malleability when subjected to high temperatures for long periods of time. Because of the short welding time the problem of brittleness in malleable iron welds may be overcome by this technique. The basic properties of materials are also being investigated for this process. For instance, the transition temperature of the base material is being established and subseqent tests on transition temperatures in the weld area will be conducted. Once the principles behind this welding process are more fully understood, the area of application may broaden considerably. In addition, knowledge will be gained of the phenomena of friction, the generation of heat by friction, and the deformation of materials.

Why Does A Culvert Cross the Road?

In our haste to construct superhighways and improved roads, it is quite easy to concentrate on large bridges, cloverleaf patterns and so forth with little thought of the smaller but all-important items such as culverts. Each year over one billion dollars is spent on the construction of culverts and these unobtrusive structures take 15 to 25 percent of the highway maintenance dollar. In fact, there are so many culverts in modern highway construction that their total construction cost exceeds the total costs of large bridges.

Obviously, culverts cross the road for one reason—to get water to the other side. The reason is easily understood, but determining the culvert size is a complex problem. It involves such uncertainties as the amount of rainfall and various types of soils and their runoff conditions. If the culvert is too big, costs are excessive; if too small, they cause floods.

In the past engineers have relied on their own past experience to make such decisions. Now a new method of determining culvert sizes which minimizes such "educated guessing" has been developed by Professor Ven Te Chow of the U. of I. Civil Engineering Department.

The new method is primarily based on scientific knowledge of the water runoff speed on various types of soils and other surfaces. Professor Chow's method has many advantages over the Talbot Formula, a method currently used for most culvert computations and proposed 74 years ago by another U of I professor, A. N. Talbot. The new method promises great savings in highway and maintenance costs, as well as in farm drainage programs and flood protection work.

Engineering students can obtain a bulletin describing the entire theory, including supporting data, pertinent hydrological information, design charts for easy use by engineers, and two bibliographies at half price from the U of I Engineering Publications Office.

A group of N.R.O.T.C. midshipmen were gathered dismally by the rail after their first day at sea. An old salt joined them and inquired sarcastically, "What's the matter, Jones, got a weak stomach?"

"Hell no," gasped Jones, "I'm throwing it as far as the others."

Mrs. Worthmore and her French poodle were shopping one day, when she noticed the man standing next to her at the counter was looking fearfully at the puppy frisking about his legs.

"My, my," she said, "don't be afraid of Felix; he won't bite you."

"Madam," said the man, "I wasn't afraid he'd bite, but I noticed him lifting his hind leg and I thought he was going to kick me."

Tech's New Look

(continued from page 5)

a student can become involved in such activities; qualifications to enter the College of Engineering Honors Program and the number of students active in the program; and changes that have been made in engineering curricula and their effect. Information on these and many other subjects has remained unavailable to most engineering students in the past. Wayne Crouch, *Technograph's* editor, has recruited a number of well-qualified staff members and is recruiting more to help him produce a new type of magazine which will provide some of this information.

From the printing of address labels on the IBM 1401 to the deletion of the joke page, *Technograph* has a new look. I wish the best of luck to editor Crouch and his staff in implementing their ideas and may they have the benefit of your support. If you agree or disagree with something in *Technograph*, let the editor know. If you feel strongly enough about the matter—write an article.

After Deon Everitt handed over his check to TECH's Editor for two dollars, the Business Monager pointed out that it was unfair to charge faculty members two dollors for a year's subscription when we were giving them the first issue free. We have since, without telling the Dean, changed the faculty subscription rate to one dollar-seventy-five—TECH is, for the first time in history, twenty-five cents in the black.

TECH MOVES

48 Electrical Engineering Building

We didn't complain when a polite wall transformed our original office in CEH into a shoe box, but when *they* installed two IBM card punch machines before our door—Well, we are now in the basement of EEB . . . next to the boiler room! This has its "heated" disadvantages, but at least more than two people can find a seat. Feel free to drop in to complain, compliment, or just shoot the breeze.

Scenery around this end of campus is improving with the increased enrollment of women engineering students. This year there are 24 women enrolled in the College of Engineering plus those in the L.A.S. departments of Chemistry, Physics, and Chemical Engineering. TECH's photographer found the girls at the home of Miss Wilson, their advisor, enjoying a picnic; and, we suspect, coordinating their stratagem to take a few of those precious A's away from the men.

Arm yourself with facts about Du Pont

These booklets helped persuade some 700 new B.S. graduates to join us in 1963. It was mostly a matter of getting facts.

For example, if you want to start your career in a certain section of the country, you'll find that Du Pont—with facilities in 28 states—will try to accommodate you.

If you're interested in growth for what it can mean to you personally, you'll be interested to know that our sales have increased 750% since 1937. You've probably heard that R&D expenditures are a good indicator of a company's future success. We spend $90 million a year on it, $60 million of which goes straight into "pioneering research"—the discovery of new scientific truths and new materials.

Our booklets will answer most of your preliminary questions. Later—or even now if you wish—we can talk specifics by letter, or face to face. Why not write us or send our coupon? We'd like to know about you.

DU PONT

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

An equal opportunity employer

TECHNICAL MEN WE'LL NEED FROM THE CLASS OF '64

Chemists
Chemical Engineers
Mechanical Engineers
Industrial Engineers
Civil Engineers
Physicists
Electrical Engineers

E. I. du Pont de Nemours & Co. (Inc.)
2531 Nemours Building, Wilmington, Delaware 19898

Please send me the literature indicated below.

- ☐ Du Pont and the College Graduate
- ☐ Mechanical Engineers at Du Pont
- ☐ Engineers at Du Pont
- ☐ Chemical Engineers at Du Pont
- ☐ Reprint of **Saturday Evening Post** article on Du Pont, July, '63.
- ☐ Also please open in my name a free STUDENT SUBSCRIPTION to the award-winning **Du Pont Magazine**—the official bi-monthly publication of the Du Pont Company.

Name_____

Class_____ Major_____ Degree expected_____

College_____

My address_____

City_____ Zone_____ State_____

We'll print either compliments, criticisms, or complaints as the pictorial heading suggests. The letters printed this month were received either the first few weeks of school or last year. TECH will try its best to answer questions and quell feuds (we might even start a few). So drop us a note. Anonymous letters will not be printed, but when requested only the Editor will have access to the names of the authors.

Dear Editor:

I wish to call attention to a minor engineering matter that has perplexed me for several years.

Many students living in the dormitories have noticed a background noise when playing their record players or radios that is particularly annoying. This interference can easily be heard on any good quality hi-fi or stereo, especially during the more restful passages of classical music.

I understand that this interference is due to the University's Betatron and its pulsing six times a second.

During the New Year's Convocation last Sunday there was a brief period when the same noise could be heard over the loudspeaker system, hence I feel this problem may exist in all buildings served by Abbott Power Plant.

Could *Technograph* determine the cause of this interference and suggest measures that would eliminate or filter out this headache?

Sincerely yours,
Walter Hadcock

Certainly some student or faculty member can devise a solution or at least tell us why none has been put into effect to date. We'll tell you, when someone tells us. Ed.

Dear Editor;

I have calculated, on the basis of probability theory, that within fifteen years the College of Engineering will be all research and no education. Seriously, I am concerned about the weight that seems to be given to research on this campus. It seems to me that these programs do nothing for the students, and I have always thought that teaching was the main mission of the college. If this is true, how can the existence of these many research programs that get so much attention and money be rationalized?

A Taxpaying Student

TECH too is concerned about research activity at the University, its relation to the undergraduate, and its relation to education. The above inquiry has prompted us to investigate further. One of our senior writers is studying the problem and preparing an article for the December issue. Ed.

Dear Editor:

I am writing because I have an old but functional submachine gun. I am hoping that you could direct me to the appropriate person to see about renting this gun to the Engineering Library.

I suspect they are about to install one as I have already had experience with their recently installed turnstile. I innocently walked through the "in" turnstile, looked but could not find the book I wanted, and was about to rush from the library before uttering those words which seem so appropriate at such a time. But my hasty retreat came to a sudden halt; it seems the "out" turnstile is LOCKED. After recovering from being turned into a ninety degree angle with a very uncomfortable vertex, I did utter those words I had been suppressing. Consider where that iron bar catches you.

Well, if they are going to use guns, I would like to get my bid in. I suppose a locked turnstile is only the first step to armed guards.

Name Withheld

One of TECH's advisors had a little run-in with that turnstile also. We'll see what Mr. Coburn, director of the library, has to say for the November issue. Ed.

Dear Sir:

A friend of mine who is a graduate student in Electrical Engineering told me that we were going to play a big part in the recent eclipse studies, but I read in *Life* only of Stanford's work. When I asked him about this article, he still maintained that we participated. If we did, why did we get so little publicity?

Name Withheld

TECH received a news release July 3 announcing that we would participate, but nothing since of our achievements. We'll check with Prof. George Swenson who, according to the news release was head of the project. Ed.

(**I.S.P.E.** *continued from page 17*)

The Illinois examination consists of two parts, the engineer-in-training and the professional. Each engineering student may take the first part during his last semester in school, the examination being held here on the campus in December and in May.

There are refresher courses sponsored by three departments to assist the senior in preparing for the Engineer in Training (E-I-T) Exam.

Civil: Oct. 9 for six sessions, Rm 110 M.E.B. 7:00-10:00 P.M. Prof. W. W. Sanders

Mechanical: Oct. 7 for seven sessions, Rm 253 M.E.B., 7:00-10:00 P.M. Prof. C. Dale Greffe

Electrical: Starts approximately same week as others. Prof. J. P. Neal

The cost will depend on the enrollment, running approximately $5.00 to $7.00. Consult each group for book and study materials. The exam itself will be held on Thursday, December 5. The application forms, which will be due in Springfield one month prior to the exam, will soon be available from the Office of the Associate Dean of Engineering, 103 C.E.H.

C. Dale Greffe, P.E., professor of Mech. Engr., is the state president of I.S.P.E. J. Raymond Carroll, P.E., a partner in the local consulting firm Carroll, Henneman, and Associates is a member of the National Board of Direction. Robert A. Jewett, P.E., Associate Prof. of General Engr., is a member of the Student Professional Development Committee at the national level.

WHO is at work on a satellite system for global telephone and TV transmission?

WHO provides the communications channels for America's missile defenses?

WHO is girdling the globe with communications for America's first man into space?

WHO tapped the sun for electric power by inventing the Solar Battery?

WHO used the moon for two-way conversations across the country?

who?

WHO guided Tiros and Echo into accurate orbit?

WHO made your pocket radio possible by inventing the Transistor?

WHO maintains the world's largest, finest industrial research facilities?

WHO supplies the most and the best telephone service in the world?

WHO has the UNIVERSAL communications organization?

THERE'S ONLY ONE ANSWER TO ALL TEN QUESTIONS

BELL TELEPHONE SYSTEM

Pioneering in outer space to improve communications on earth